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PLASMOCYTOMA OF THE NASAL CAVITY
THOMAS J. TAYLOR, M.D., ET AL.

HEAD AND NECK PAIN
BERNARD WELT, M.D.

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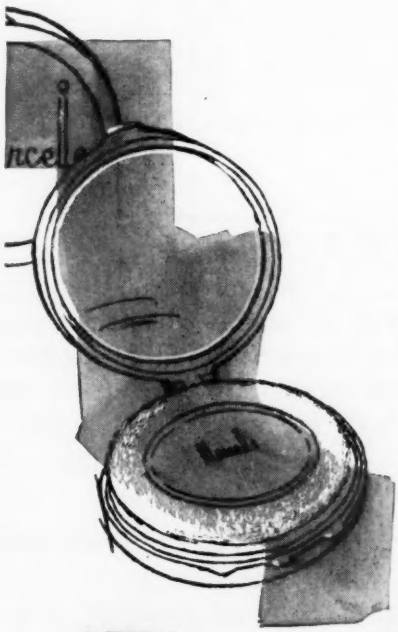

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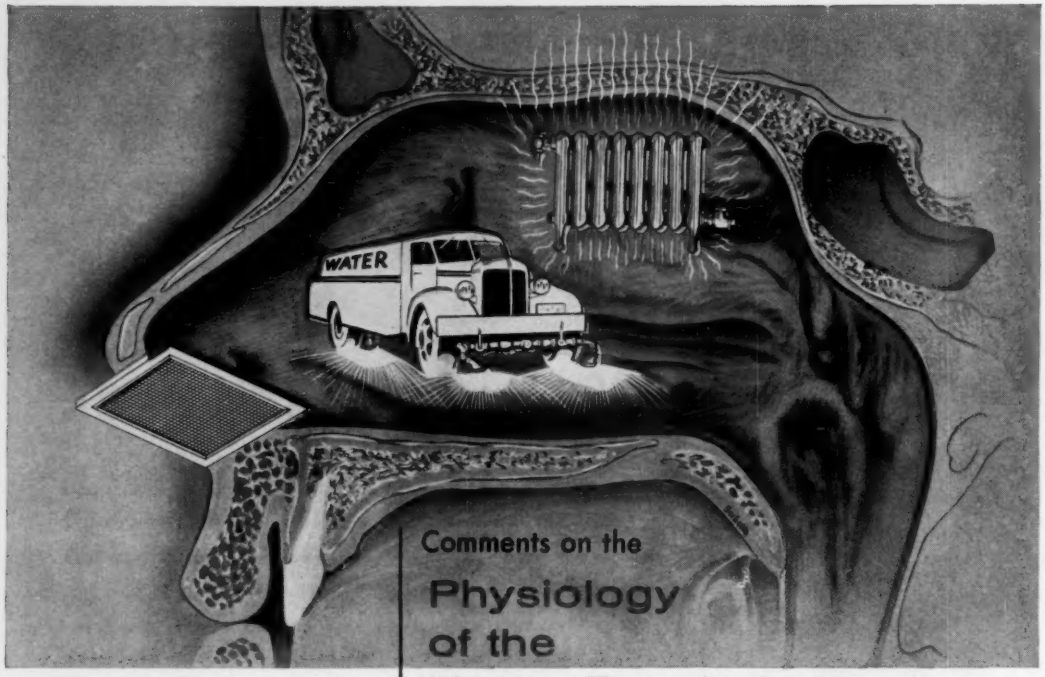

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Endobronchial Placer Mining for Neoplastic Cells

JOHN B. GREGG, M.D., Sioux Falls, S. D.
BYRON M. MERKEL, M.D., Des Moines, Iowa
and
KENNETH R. CROSS, M.D., Iowa City

In recent years, with the advent of mass survey chest x-rays, the emphasis placed upon diagnosis of pulmonary pathology,* and the increasing incidence of neoplasm, the subject of lung cancer has received widespread attention. Fortunately, the primary effort has been directed toward early diagnosis and therapy because of the severity of this lesion. With the emphasis on case finding, the problem of demonstrating abnormal tissue for diagnosis prior to surgery has fallen upon the endoscopist. Unfortunately, in many early lung lesions, direct examination with the bronchoscope shows little or no evidence of neoplastic activity. In such cases biopsy becomes haphazard and of doubtful value. It is in these cases that directed, excoriating aspirations of small tissue fragments and cell clumps have proved to be of great value.

The diagnosis of lung neoplasms by bronchoscopic examination has showed disparity in positive results, varying from 30% to as high as 80%.† Because of the inconsistency in results, bronchoscopy for diagnosis of lung cancer has fallen into disrepute in some places. With the development of cytological examination of exfoliated cells obtained from suspicious areas, a new facet of bronchoscopy was opened.

In 1946 Herbut and Clerf [27] summarized the available literature concerning sputum and bronchial mucous specimens used in the diagnosis of lung pathology and concluded that examination of bronchial mucus was definitely helpful in proving the presence of lung cancer. Since that time the literature has been flooded with discussions concerning the cytological diagnosis of lung cancer, with considerable variability in results.‡ Because of the inconsistency in positive results with bronchoscopy and cytology methods, there have been many methods developed for obtaining and examining specimens. These include the use of various bronchoscopes, telescope bronchoscopes,[67] ureteral catheters for bronchiolar catheterization,[68] Gelfoam and sponge biopsies,§ special aspirating devices and cannulae,‖ special biopsy forceps,¶ transthoracic aspiration biopsy,# the use of trypsin and other substances to improve the specimens,* utilization of direct smears and fixed specimens, and various stains.† Even with the multiplicity of techniques, a significant proportion of the bronchoscopic and cytological examinations in lung-cancer patients are negative.

Exfoliative cytology techniques depend upon the principle that neoplastic tissue in its rapid growth exfoliates or sheds cells. These present a picture which is often histologically different from normal cells. However, some tumors can not be diagnosed easily by cytol-

From the Otolaryngology Section, U. S. V. A. Hospital, Iowa City, Iowa (Dr. Gregg). Attending in Otolaryngology, U. S. V. A. Hospital, Des Moines, Iowa (Dr. Merkel). From the Pathology Departments, U. S. V. A. Hospital and the College of Medicine, State University of Iowa, Iowa City, Iowa (Dr. Cross).

* References 1 to 5.

† References 6 to 26.

‡ References 28 to 66.

§ References 12, 13, 69, and 70.

‖ References 47, 62, and 71.

¶ References 12, 13, 67, and 72.

References 73 to 75.

* References 76 and 77.

† References 78 and 79.

ogy methods, due to the fact that they grow slowly and do not shed many cells, are located in such a position that the discarded cells do not find their way to the outside easily,‡ or because individual tumor cells differ so little from normal cells that distinction is impossible.

In 1949 two of us (B. M. M. and K. R. C.)[82] reported experiences with a modification of the usual bronchial cytology technique, based on a series of 101 specimens. In this report, primarily from the pathological standpoint, we observed results which we considered to be encouraging in the diagnosis of lung cancers. More recently two of us (J. B. G. and K. R. C.) have been utilizing this technique, with minor modifications, with good results. We herewith report our technique and results.

TECHNIQUE

The principle utilized in this technique for obtaining neoplastic cells can be compared to the "placer" method of mining gold, in which a forceful stream of water is used to wash gold particles into a container so that they may be more easily and efficiently separated. Irrigation and washing of bronchiolar orifices has been advocated previously as a method of increasing the cellular content of aspirated specimens, but in some tumors, especially those which are submucosal, the yield has been scanty. For this reason we actually abrade the bronchial mucosa in the suspected area with the suction tip to separate small flecks of mucosa. We then irrigate these areas so treated with a jet of saline and suck the mixture into a collecting vial. The suction apparatus is employed in the same way that the endoscopic biopsy forceps is used. The use of the thumb valve corresponds to closing and opening the forceps. The tissue obtained represents minute biopsies of the mucosa, which are collected by irrigation and aspiration. In this way we are able to increase the amount of tissue available for examination and to obtain specimens from areas which are not available to the biopsy forceps.

Of great importance also is the fact that we have a specimen, a group of small biopsies, which can be centrifuged, fixed, blocked, sectioned, and treated just as any other surgical specimen. This can be examined by the pathologist without the intervention of an expensive and time-consuming "cytology laboratory." The pathologist has small islands of tissue in which polarity as well as cytologic features can be evaluated, and these are prepared and stained by methods with which he works daily.

In utilizing this tissue-procurement method, there are certain specific details which we have found to be important. These are the following:

1. Thorough preliminary evaluation of the patient with x-rays to determine the exact location of the pulmonary pathology is important. When using the placer-mining technique, it is important to localize the lesion insofar as possible in the affected lobe and segment.

2. The bronchial tree is exposed with a Jackson bronchoscope, inspected directly and with the telescope bronchoscopes, and any unusual or suspicious areas noted. If lesions are available to the forceps, a biopsy specimen is taken. "Cytology" specimens are then always obtained by washing the biopsy site. Occasionally the tissue specimen has been negative, but the bronchial washings have been diagnostic of neoplasm.

3. For obtaining specimens we use either the Clerf Cancer Cell Specimen Collector with Jackson open-end and open-side aspirating tips or the Tucker flexible-tip aspirating tubes; or the Carabelli aspirator-irrigator apparatus. Before collecting the specimen, the collecting cannulae and tubes are thoroughly flushed with saline to prevent cells from sticking to the apparatus.

4. If direct examination is negative, the suspected area is exposed carefully, the suction cannula introduced, and any mucus within the bronchiolar orifice collected. The cannula is then inserted further into the lumen and the mucosa carefully abraded with the aspirating tip so as to flake off small pieces of epithelium and underlying stroma. In the upper lobes the curved, spring-tipped cannulae are used to good advantage. The minute pieces of tissue are aspirated into the collection vial. The area is then washed repeatedly and forcefully with saline and the material aspirated promptly. In cases with more than one suspicious region, individual specimens are obtained from each place and the collection vials are carefully labeled. In contradistinction to the usual cytology technique, we do not consider this procedure to be well done unless a little hemoglobin is present in the specimen.

5. Immediately after bronchoscopy, the aspirating tubes are flushed with alcohol-formalin (10 parts of concentrated 40% aqueous formaldehyde in 90 parts of 95% alcohol) to collect any remaining cell clusters. An equal amount of the fixative is then added to the vial, and it is sent to the laboratory promptly. There slow centrifugation is started immediately, and a button is made from the centrifugate. This is treated as a tissue specimen; paraffin blocks are made and cut just as and along with those from other surgical specimens. These

‡ References 80 and 81.

are stained with hematoxylin and eosin along with the other slides. The four sections which are made from different levels of each block are examined by the pathologist. No special techniques or equipment are used, and no additional personnel are required.

6. The slides are graded 1 to 5 suggestive of neoplasm on the basis of the degree of anaplasia and loss of polarity present. It is attempted to differentiate inflammatory from neoplastic anaplasia. A diagnosis of 3+ is considered to be suggestive of neoplasm and 5+ diagnostic.

7. In any case in which the findings are equivocal the patient is rebronchoscoped and additional specimens obtained from the suspected areas.

COMMENT

Because of the inaccessibility of many lung neoplasms to direct inspection, bronchoscopy as a diagnostic tool has received unfavorable reputation. With the use of sputum and bronchial mucous specimens for study of cellular morphology, the diagnosis of neoplastic lesions has improved. By utilization of endoscopically directed bronchial abrasion, irrigation, and aspiration of the mucosa, an even higher percentage of positive diagnoses can be established by endoscopic methods. To date the only complication we have seen following bronchoscopy and "placer mining" was one pneumothorax, which occurred 24 hours post bronchoscopy. This subsided on conservative treatment. Contrary to what might be anticipated, there has been no evidence of endobronchial seeding of neoplasm. We have been privileged to rebronchoscope 22 patients upon whom "placer mining" had been performed from five days to two months previously. We found no evidence of residual injury from this procedure. The endobronchial mucosa had reverted to its previous state or to normal bronchial epithelium in the interval between examinations in all cases, including those of only five days.

We have found that this technique is easy for the bronchoscopy team and is far less expensive in terms of man hours spent per cytology specimen in the laboratory. After thorough inculcation of the bronchoscopy-cytology unit, results were quite accurate and dependable. The biggest difficulty still remaining is the differentiation of chronic inflammatory from neoplastic anaplasia, particularly in small fragments of squamous epithelium. The second largest source of error has been the failure of the bronchoscopist to be energetic enough in obtaining tissue fragments for examination. The former difficulty is inversely proportional to the experience of the pathologist reading the specimens. The adequacy of the specimen obtained depends much upon the experience of the bronchoscopist. However, the endoscopy technique and the recognition of changes seen in the slides are easily learned. We believe that the interpretation of specimens obtained should rest in the hands of the pathologist, and not in the hands of a "cytology technician." The pathologist by virtue of his long experience in observing cellular changes is better qualified to interpret the findings seen in the specimen.

With this technique the results, as with other perbronchoscopy techniques, are better when the lesion is present in the lower or middle lobes, and in endobronchial lesions. However, with telescope bronchoscopes and curved aspirating tips, good specimens are also obtained from the upper lobes. Tumors which are located in the lung parenchyma and which do not exfoliate to any extent yield poor results in any cytology examination. The location of lung neoplasms in our series closely parallels other series (Table 1). The age group represented in this series is summarized in Table 2.

TABLE 1.—*Location of Lung Neoplasms*

Location	Epidermoid Carcinoma, No.	Adenocarcinoma, No.
Right upper lobe	6	3
Right middle lobe	1	0
Right lower lobe	5	3
Left upper lobe	6	2
Left lower lobe	6	3
Primary unknown	0	1

TABLE 2.—*Age Incidence of Patients with Lung Neoplasms*

	Epidermoid Carcinoma, Yr.	Adenocarcinoma, Yr.
Average age	57	60
Age range	36 to 66	53 to 66

False positive and false negative results occur. The former are most frequently associated with the difficulty in differentiation of chronic inflammation from neoplasm. We feel that false negative specimens are largely the fault of the endoscopist for furnishing inadequate cellular material. Occasionally false negative specimens are due to improper handling of the material before it gets to the pathologist. Autolysis of neoplastic cells occurs rapidly and is easily preventable.

RESULTS

In the past year we have performed 190 bronchoscopies on 168 patients. The pathological processes represented varied from tuberculosis to cancer. One hundred twenty-eight different cytology specimens were obtained with these examinations. During the period under study there were 37 patients with proved new lung tumors admitted to the hospital. Of these, one was diagnosed primarily at autopsy, in one the diagnosis was made at thoracotomy, with x-ray evidence of a peripheral lung lesion, and in four the lung lesion was not suspected or the patient was moribund and diagnostic procedures were not done. In this group of patients with lung tumor there were 24 epidermoid carcinomas, 12 adenocarcinomas or round-cell carcinomas, and 1 chondroma within the lung.

Thirty of the patients with malignant neoplasms and the one with an endobronchial chondroma were bronchoscoped. We were able to see evidence of specific lung pathology, i. e., stricture, focal edema and inflammation, gross neoplasm, carinal thickening, or other findings suggesting localized disease, in 70% of these patients. From the patients with malignant neoplasms, bronchial washings which were strongly suggestive or diagnostic of malignancy were obtained in 19, or 63%. Negative reports were given three times on one patient. In all, only five cases were referred to the bronchoscopy clinic in which evidence of the lesion could not be seen or in which the aspirated specimen was not diagnostic. Thus, we were able to suggest the presence of lung cancer by the results of bronchoscopic examination and examination of bronchial washings in 80% of the cases examined.

During the examination of the 128 aspirations or washings, the department of pathology reported specimens to be 3 or 4+ suggestive of malignancy (on the basis of 1 to 5+) in seven instances. Four of these reports were on two patients, both of whom were rebronchoscoped. There were thus five patients on whom false positive impressions were given.

In the previous paper by two of us (B. M. and K. C.) it was pointed out that in the first 24 patients with bronchial neoplasms studied the incidence of positive bronchial washings was 54%. In the next 46 patients, positive diagnoses were made in 82.3% of them. We concluded that the improvement was the result of two factors: additional experience on the part of the pathologist and, more especially, experience and confidence in the method on the part of the bronchoscopist. It is only with experience that the bronchoscopist becomes bold enough to actually irritate the bronchial mucosa and obtain "small biopsies" in the recovered material. In this paper is recorded the first experience of the senior author with the method. The efficiency and accuracy of the procedure have shown progressive improvement from the beginning.

When we began this series using this technique of bronchial aspiration, the results were disappointing. However, as the endoscopic team became more proficient in the method and the pathologist received better specimens, the incidence of positive and accurate results increased. At the beginning of the period under study we obtained cytology specimens in an irregular manner, usually only in cases suspected of neoplasm. We now obtain cytology specimens in all cases which come to bronchoscopy.

REPORT OF CASES

CASE 1.—A 64-year-old man complained of hoarseness and slight dysphagia, 20 lb. (9 kg.) weight loss, cough for many years, and hemoptysis on one occasion. Physical examination showed left vocal cord paresis but no other significant finding. Chest

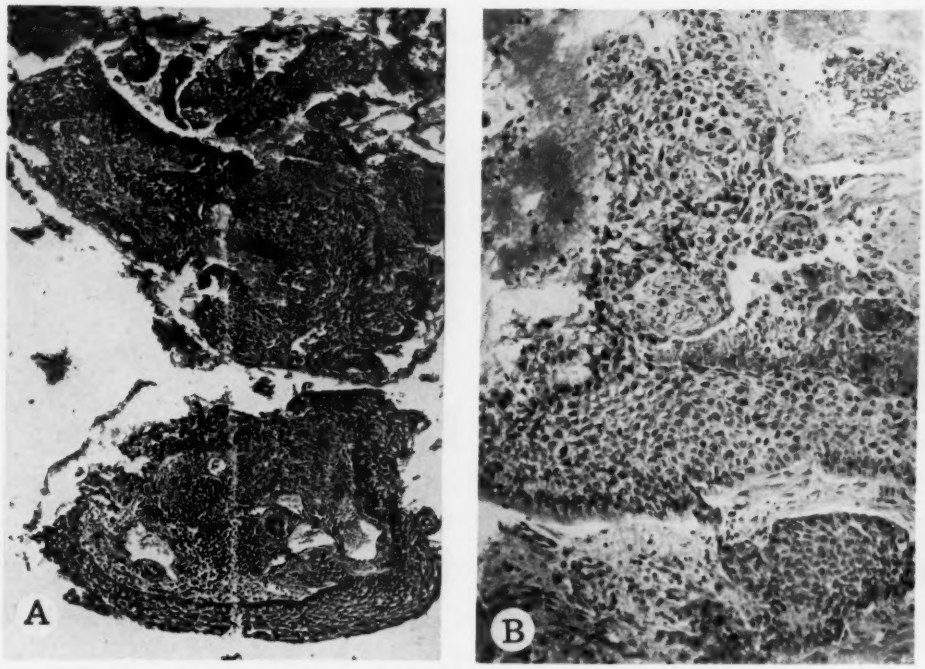


Fig. 1 (Case 1).—*A*, Small "biopsy" in bronchial washing; hematoxylin and eosin; × 90.
B, Higher magnification to show malignant anaplasia; hematoxylin and eosin; × 120.

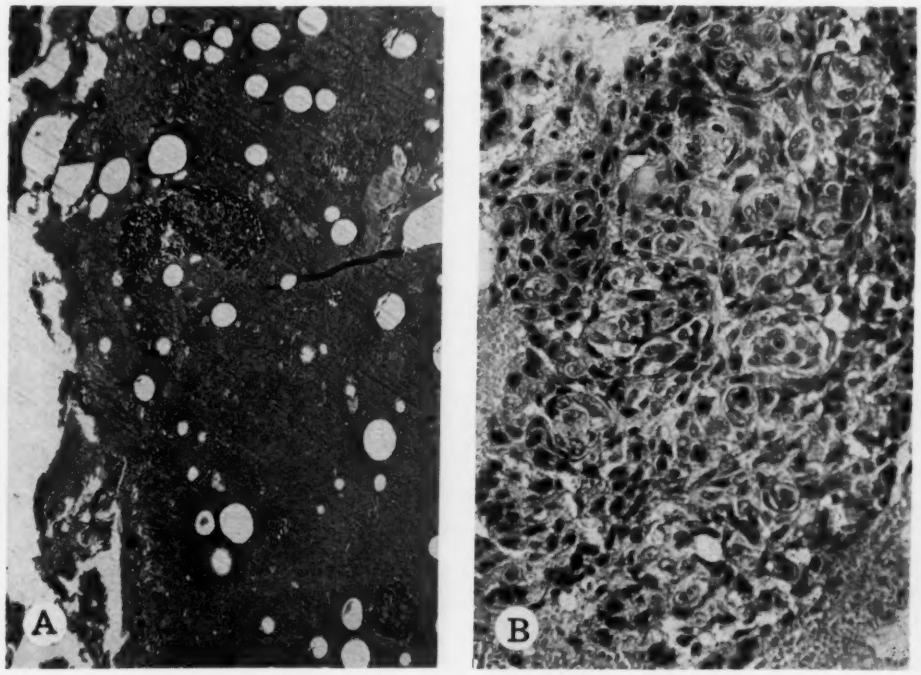


Fig. 2 (Case 2).—*A*, Small "biopsies" in bronchial washing; hematoxylin and eosin; × 71
B, Higher magnification to show malignant anaplasia; hematoxylin and eosin; × 245.

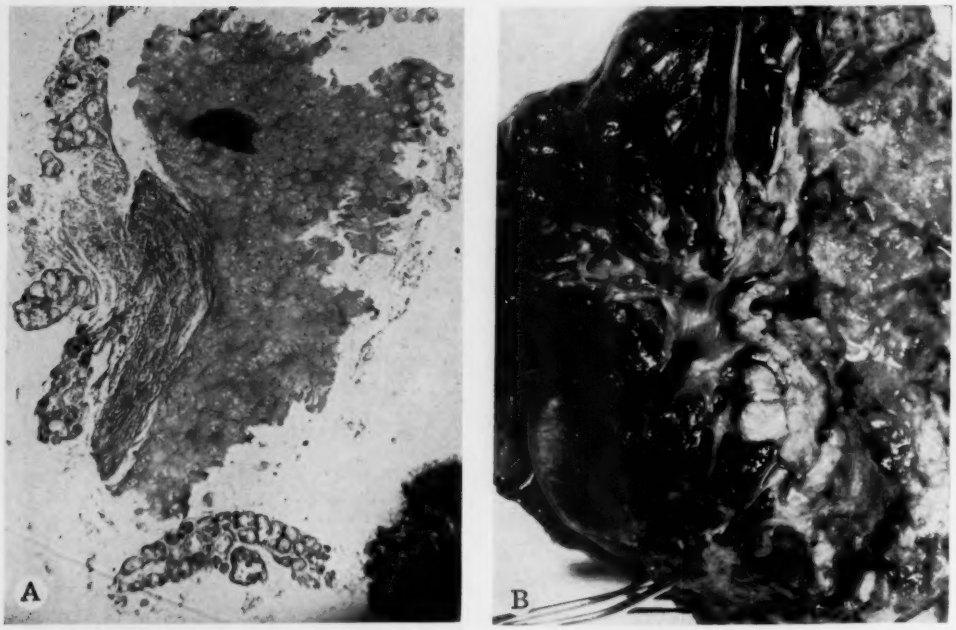


Fig. 3 (Case 2).—*A*, Negative biopsy; hematoxylin and eosin; reduced ⅓ from mag. × 71. *B*, Epidermoid carcinoma, left upper lobe bronchus.

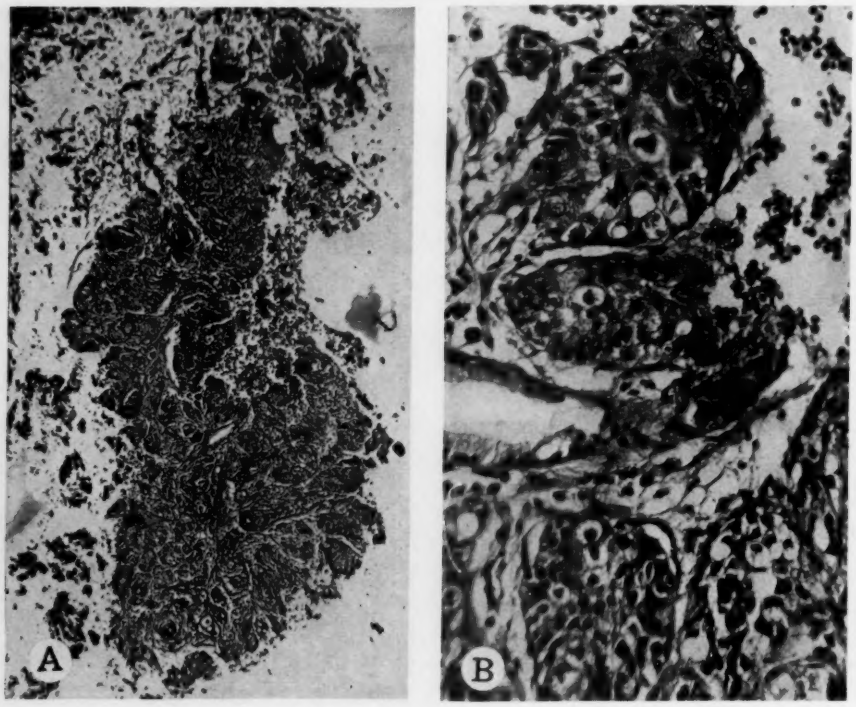


Fig. 4 (Case 3).—*A*, Small "biopsy" in bronchial washing; hematoxylin and eosin; × 31. *B*, Higher magnification to show malignant anaplasia; hematoxylin and eosin; × 125.

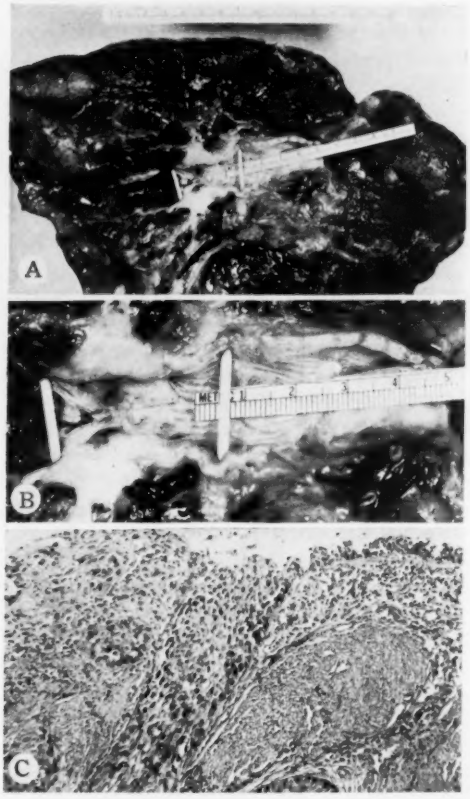


Fig. 5 (Case 3).—*A*, Carcinoma in left lower lobe bronchus. *B*, Closer view of *A*. *C*, Resected lung, poorly differentiated epidermoid carcinoma; hematoxylin and eosin; reduced ⅛ from mag. × 108.

x-ray was interpreted as normal. Bronchoscopy showed stenosis in the left lower lobe bronchus. Biopsy showed anaplasia and squamous metaplasia of the bronchial mucosa. The cytology specimen contained fragments of epidermoid carcinoma (Fig. 1). The patient was a poor operative risk, and definitive therapy was considered inadvisable.

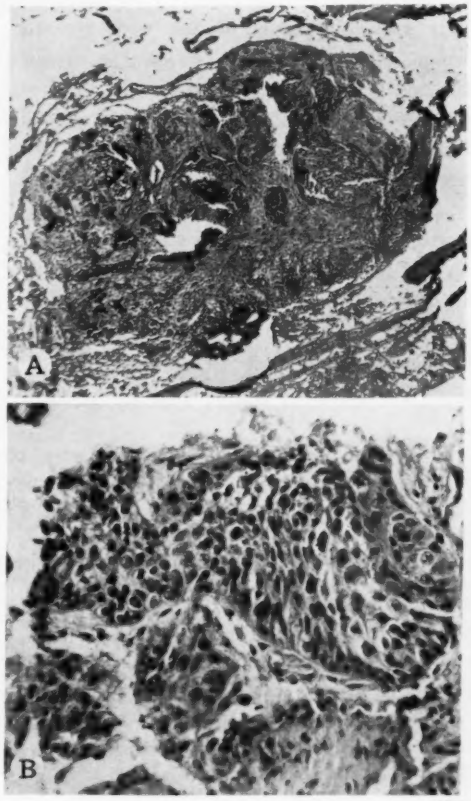
Case 2.—The patient, a 58-year-old man, complained of left chest pain and episodes of hemoptysis for eight weeks. Chest x-rays showed atelectasis of the left upper lobe. Bronchoscopic examination was reported negative for tumor (Fig. 3*A*). The cytology specimen was strongly positive for epidermoid carcinoma (Fig. 2). A left pneumonectomy was performed (Fig. 3*B*).

Case 3.—A 53-year-old man complained of chest pain, fatigability, and nervousness for three months. Chest x-ray showed pneumonitis, left lower lobe. At bronchoscopy mucosal edema in the left lower lobe bronchus was seen. The cytology specimen was positive (Fig. 4), the pathological diagnosis being poorly differentiated epidermoid carcinoma. Left pneumonectomy was performed (Fig. 5).

Case 4.—This 62-year-old man complained of weakness, weight loss, cough, and right chest pain for two months. Chest x-ray showed right lower lobe pneumonia. Stricture in the right lower lobe bronchus was seen on bronchoscopy. The cytology and biopsy specimens (Fig. 6) were positive for epidermoid carcinoma. The lesion was found to be inoperable.

Case 5.—A 60-year-old man was examined because routine chest x-ray showed a round, dense mass in the periphery of the right middle lobe. Bronchoscopy was negative, but the cytology specimen was suggestive of carcinoma. The middle lobe was removed; the tumor proved to be a chondroma histologically. An incidental finding within the middle lobe bronchus was a small focus of anaplasia, which might be called carcinoma in situ. The aspirated specimen considered to be suggestive of malig-

Fig. 6 (Case 4).—*A*, Small "biopsy" in bronchial washing; hematoxylin and eosin; reduced ⅛ from mag. × 71. *B*, Higher magnification to show malignant anaplasia; hematoxylin and eosin; reduced slightly from mag. × 245.



nancy may well have been obtained from this area. This is considered to be a false positive report in our calculation, but it does illustrate the borderline diagnostic problems in both aspirated material and fixed sections.

CONCLUSIONS

We have found that the best results with the cytology technique we use are obtained in endobronchial lesions, which in our cases have been predominately epidermoid carcinomas. The peripherally located tumors and the parenchymal lesions are less frequently diagnosed with the cytology methods. We attribute this to the smaller number of exfoliated neoplastic cells. However, by "placer mining" we are able to increase the number of neoplastic cell clumps in the specimen and achieve more positive results. It has been shown that the epidermoid group of lung tumors, usually located within the bronchi or within the mucosa of the bronchi, are increasing in number,[83] while the adenocarcinoma group is remaining about the same statistically. For this reason it is important that early diagnosis of the endobronchial lesions be promoted. The placer mining method of obtaining neoplastic tissue offers greater chance of securing abnormal cells than does simple aspiration of mucus from the bronchial lumen. This method of examination can be accomplished in the pathology department of any hospital without the addition of new techniques, with existing equipment and supplies, and with only a slight increase in the work load of current personnel.

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Plasmocytoma of the Nasal Cavity

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A plasmocytoma is a growth composed of plasma cells and is similar to a lymphoma in its gross characteristics. A plasma cell is a cell with a nucleus situated at one pole and with the nuclear chromatin having a spoke-like arrangement. The cytoplasm is basophilic, and there is a pale area near the nucleus, which contains a diplosome. Eosinophilic granules and crystals appear in the protoplasm when the cell is degenerated or during certain virus infections. These have been described as Russell's or Una's bodies. Plasmocytomas, under certain conditions, may assume malignant characteristics and, under these circumstances, they grow rapidly and infiltrate the surrounding structures. Plasmocytomas are seen in the nose, turbinates, and nasopharynx, where they appear as infiltrative or pedunculated growths covered with a reddish mucosa. Plasma-cell myeloma of the bone marrow and plasmocytomas have similar cell structure but are entirely different in their clinical course and gross appearance. In the nose and throat, plasmocytomas are slow-growing, sclerosing, and infiltrating growths with considerable cellularity and vascularity. Metastasis is rare unless they become malignant, and then they are spoken of as plasmocytic sarcomas. Plasma-cell myelomas are highly cellular, extremely vascular, and rapidly growing, with early and frequent metastasis. Plasma-cell myelomas of the skeletal structure may metastasize to the nose or nasal sinuses.

At times a lymphoid or plasma-cell tumor, not uncommonly found primarily in the gastrointestinal tract, may metastasize to the ear, nose, and throat structures. When a plasmocytic tumor is encountered in the upper respiratory tract, care should be exercised in an attempt to locate a primary growth in the bone marrow or gastrointestinal tract.

Isolated plasma-cell tumors of the nasal cavity not the result of metastasis or associated with multiple myeloma are extremely rare. The following case is interesting because it is such a tumor and because it reveals a characteristic tendency to recur after surgical extirpation.

REPORT OF A CASE

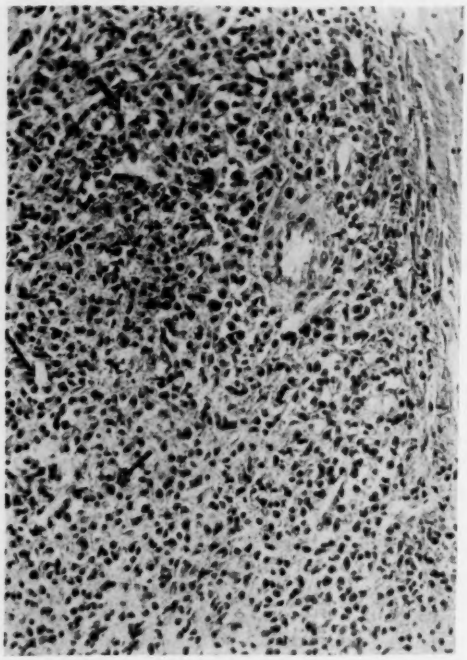
A 61-year-old well-developed, well-nourished white man was first examined on Feb. 25, 1954, at which time he was seen as an outpatient and complained that he had a blockage to the airway of his right nostril and a swelling and soreness in this area. The history dated back to December, 1952, at which time, while he was living in another city, his nose became stuffy and completely obstructed, forcing him to report to an otolaryngologist in that city. The attending physician found a firm mass in the right nostril, which was removed, and a submucous resection was performed. The report made at that time by the pathologist showed a polypoid structure composed of eosinophilic cells containing large nuclei. He made a diagnosis of plasmocytoma.

After the surgery in 1952, the airway in the nose remained normal until approximately six months prior to examination, at which time he began to notice obstruction again. He failed to have treatment until the nose became sore and painful, approximately one week prior to examination.

Examination in the office revealed a tender swelling of the right ala and about the right nasal labial fold, extending over the dorsum. Body temperature was not elevated, and there did not

appear any point of localization. The interior of the right naris was completely blocked with a mulberry-like polypoid mass, which on palpation completely blocked the entire right nasal cavity. A diagnosis of cellulitis of the nose with preexisting and recurring tumor was made, and the patient was placed on intensive antibiotic medication. A soft, tender preauricular lymph node was palpated in the area of the right ear. It was believed to be purely inflammatory, and subsided with medication.

On March 8, the patient was admitted to St. Peter's Hospital, in Olympia, Wash., for surgery of the nose. At surgery a large polypoid granulomatous mass was noted to be filling the entire right nasal vault. The mass was seized with a rongeur



High-power section (reduced 50% in reproduction) showing areas in which the nuclear detail is most clear, and demonstrating (1) characteristic nucleus, (2) eccentrical position of the nucleus, (3) occasional multinucleated forms, and (4) generalized monotony of cell types.

and was found to be extremely friable and was removed quite easily. About 20 gm. of tissue was removed piecemeal following down through the anterior aspect of the right inferior turbinate. The growth had extended down to the floor of the nose and across to the septum in the midline. Considerable bleeding and oozing was encountered, which was easily controlled by pressure with packing. When the surgery was completed and the nose appeared completely clean, the nasal vault appeared to be within normal limits, with the exception that the anterior half of the right turbinate had been destroyed. At no time during the surgery was any bone encountered in this area, and it is assumed that this was destroyed by the infiltrative mass. The lateral nasal wall and floor of the nose were palpated, and the bone was found to be intact throughout. No soft spots were noted, and there did not appear to be any erosion to the maxillary antrum. The entire specimen was sent to the pathologist for examination.

The postoperative course was uneventful, and there was no excessive bleeding at any time. The patient was discharged March 10, 1954, for deep x-ray therapy on an outpatient basis. The following treatment was given to the nose and to the area of the right ear, since postoperative examination revealed some slight swelling in the region of the preauricular node. A total of 4876 r, as measured in air, was delivered in 18 treatment days, from March 12, 1954, to April 30, 1954. Of this, 2332 r was given through a 5 by 5 cm. portal over the nose, including airways and ethmoids. Then 2544 r was given through a right 6 by 8 cm. preauricular port because of a 1.5 by 2 cm. node here. This port included the node and was also directed to the nasopharynx. X-rays were generated at 200 kvp, with 50 cm. target distance, and 0.5 mm. Cu and 1 mm. Al filtration were used. Treatment was well tolerated. The red blood cell count was 9400, with 82% polychromatic forms, 4% eosinophiles, 12% normal lymphocytes, and 2% monocytes.

Sinus films were taken in the hospital prior to surgery and were reported as follows: "Films of the paranasal sinuses show the frontals to be small but present. The sphenoid maxillary and ethmoid cells appear to be well developed. There is clouding in the right side of the nose and over the ethmoids. There is clouding of the left maxillary sinus as compared with the right. There is no apparent destruction of the bones in the region of the nose or maxillary areas. The skull is fairly well seen in the frontal and lateral projection and there is no suggestion of myeloma."

When last examined, June 30, 1954, the entire right nose was completely clear and there was no evidence of recurrence of the tumor mass. Blood studies on June 21, 1954, revealed hemoglobin, 13.3 gm.; red cell count, 4,730,000; color index, 0.87; white blood cell count, 12,140; polymorphonuclear cells, 75%; lymphocytes, 23%; monocytes, 2%. Urinalysis was normal. Total blood protein was 8.89 gm., albumin was 4.87 gm., and the globulin was 4.02 gm. A test for Bence Jones protein was negative. On June 3, 1954, a complete, serialized review of the entire skeletal system was made by the radiologist, and he found no evidence of any metastatic disease nor any replacement bone disease in any of the bones demonstrated.

This is a case of plasmocytoma of the right inferior turbinate which, apparently, is isolated. The postoperative course, to date, is good.

319 Security Building.

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Head and Neck Pain

Role of Biological Imbalance in Its Pathogenesis and Therapy

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INTRODUCTION

In an earlier article,[2] I presented the results of an investigation of the physiopathological aspects of postoperative wounds and the use of *n*-butyl alcohol (*n*-butanol) in the control of the postoperative pain in otorhinolaryngologic surgery. In a second article,[1] I presented the results of a similar study of the physiopathological characteristics of the symptoms of vertigo. The results of these two studies confirmed the findings of Revici about the biochemical processes taking place in pathological tissues.

The beneficial effects of *n*-butyl alcohol on traumatic pain and the beneficial effects of lipids with acid or hydroxyl polar groups when used to influence the abnormal metabolic processes of foci that manifest themselves as acid or alkaline symptoms have all confirmed Revici's concepts of the role of lipids in the pathogenesis of these conditions. The imbalance in the form of a dual biochemical pattern in pathological processes represents a new approach to the study of conditions with various etiologic causes. In both communications, I presented a summary and outline of Revici's hypothesis, explaining these physiopathological mechanisms with the simplified approach for the study of symptoms resulting from various etiologies.

It is from this same point of view that I studied the problems relating to the relief of head and neck pain. The application of this concept to the problem of head and neck pain is summarized in Table 1.

The most cursory survey of the problem indicates that all serious students of the subject accept an approach that involves the acceptance of multiple etiologic mechanisms.* Headache or neck pain can be induced by known and easily recognized structural changes, i. e., neoplasms, inflammation, trauma, vitamin deficiencies, cardiovascular disease, allergy, viral disease, endocrine disturbances, drug poisoning, etc. In other conditions, such as migraine, tic douloureux, and tension headaches, the actual structural changes are often unknown, and several factors have been considered to be involved.

The mechanism of the initiation of the pain associated with the above conditions has never been clearly established. Because of the multiple etiological factors usually involved, attempts were made to clarify the problems of the production of pain by considering the mechanism involved. Processes such as vasoconstriction, vasodilation, edema, inflammation, and mechanical compression were discussed and described. These factors undoubtedly are directly related to the appearance of head and neck pain but do not explain with conviction the occurrence of pain related to the abnormal process. Through the study of the biochemical changes which occur in pain-producing lesions, e. g., wounds in animals, Revici and his associates have presented evidence that points to a pathway leading to an adequate explanation of the evolution of pain in many pathological states. This dualistic concept accepts the older etiologic and pathogenic factors hitherto described, but leads to a more fundamental understanding of the mechanism of the painful symptom.

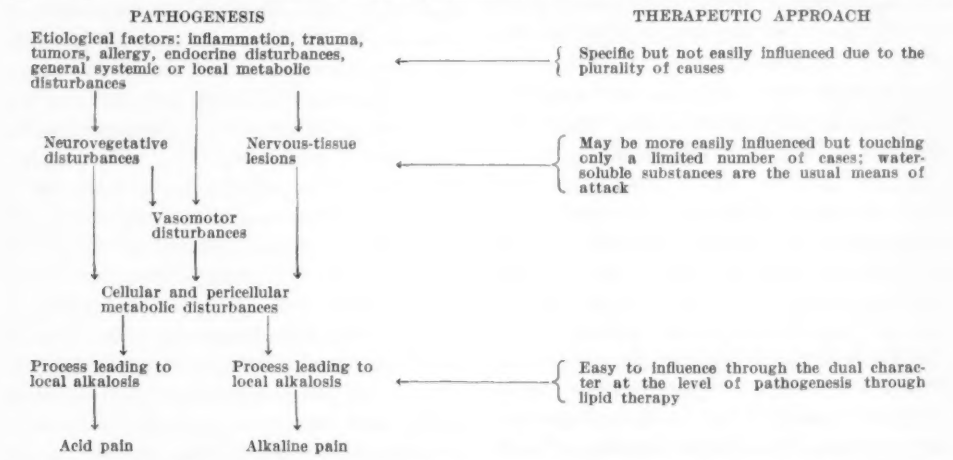
From the Ear, Nose and Throat Department of the Brooklyn Eye and Ear Hospital.

Table 12 and Figures 1 and 3 were utilized to illustrate a Panel Discussion on the Treatment of Pathological Pain in Otolaryngology at the Academy of Ophthalmology and Otolaryngology Meeting, New York, Sept. 21 and 22, 1954.

* References 6 to 8.

According to the dualistic concept, the basic metabolic changes in the cells can be reduced to only two aspects in which the increase or decrease of the permeability of a cell membrane can represent the ultimate mechanism involved. According to this concept, the decreased permeability leads to metabolism, which can account for the anoxybiotic type, while the increase in permeability favors a series of processes which were described by Revici as dysoxybiotic. The anabolic character of the first type and the catabolic character of the second type can be largely explained by the changes in the permeability changes are followed by the appearance of acid or alkaline substances in the intercellular fluid. It is this local acidosis or local alkalosis which ultimately can be considered to be responsible for the pathological pain or symptoms, such as vertigo, etc. This point of view permits the correlation of the dualistic concept concerning symptoms with the accepted multiple pathogenic mechanisms and the various pathological factors accepted as the causes of pain in head and neck syndromes. With this concept in mind that has been developed by Revici in the course of his studies, I undertook the investigation of the

TABLE 1.—*Application of Revici's Hypothesis in the Treatment of Head and Neck Pain*


PATHOGENESIS
THERAPEUTIC APPROACH
Etiological factors: inflammation, trauma, tumors, allergy, endocrine disturbances, general systemic or local metabolic disturbances
Specific but not easily influenced due to the plurality of causes
Neurovegetative disturbances
Nervous-tissue lesions
May be more easily influenced but touching only a limited number of cases; water-soluble substances are the usual means of attack
Vasomotor disturbances
Cellular and pericellular metabolic disturbances
Process leading to local alkalosis
Process leading to local alkalosis
Easy to influence through the dual character at the level of pathogenesis through lipid therapy
Acid pain
Alkaline pain

meability. Because of the part played by the lipids in the constitution of the cell membranes, the intervention of lipids with acidic or hydroxylic radicals, according to the view, is one of the factors which determine the change in permeability.

Hormones or nerve impulses from the sympathetic and parasympathetic nervous system lead to changes in the permeability of the cells too † and, consequently, to the same two types of metabolic imbalance. Thus this dualism appears largely as a result of a change in permeability in two opposite directions. Two opposite abnormal cellular metabolisms resulting from these permeacomplex problem of head and neck pain in this presentation.

The entire problem of headache is presented here at the purely clinical level. I have tried to show that the substances used to evoke a response, either beneficial or not, are in keeping with the above concepts. I have indicated the theoretical parts of the problem only insofar as it was necessary to make the practical application of the methods derived from these concepts understandable. I have given an outline of Revici's hypothesis in my earlier communications. In view of its importance and that it presents a new point of view, it will not be amiss to again present it in brief outline.

† References 3 to 5.

The hypothesis states that many pathological conditions with or without structural changes recognized by means used will show by appropriate methods of examination an abnormal metabolic process manifested as a dualism. Locally, at the lesion site, this dualistic pattern appears as a local acidosis or a local alkalosis. When the symptoms of pain and vertigo were examined, two types were recognized and confirmed, i. e., an acid type or an alkaline type of pain and vertigo. These symptoms responded in an opposite manner to spontaneous or induced changes in the acid-base balance of the body.

The application of this concept to the problem of head and neck pain confirmed the dualistic nature of the symptoms and points the way for a new therapeutic approach that would be useful in the field of otolaryngology.

The two types of abnormal metabolic processes which lead to a local acidosis or alkalosis determine the appearance of symptoms, the nature of which depends upon the tissue or organ involved. Pathological involvement of the tissues of the skin will produce painful impulses transmitted via the peripheral nerves to the central nervous system.[9] Involvement of the cochlear vestibular apparatus will produce the symptom of impaired hearing, vertigo, or both. Pathological foci in the lungs or bronchi produce the symptom of cough or dyspnea. Certain lesions of the skin and mucous membranes produce the symptom of itching as a predominant symptom. One can think of many symptoms, the character and nature of which is dependent upon the tissue involved. More than one pathological lesion can be present in the same patient in different regions of the body and may cause symptoms which, when properly analyzed, will present an alkaline or acid metabolic pattern.[10] If two such lesions have the same metabolic pattern, both will react in a like manner to spontaneous changes in the acid-base balance of the body. When the symptoms are unlike, each will reach its period of greatest intensity at different times of the day, depending upon the natural acid-base changes that occur in the 24-hour cycle. In the evening, the alkaline symptom will usually be intensified as the result of the greater alkalinity of the body, while in the morning, the acid symptom will reach its greatest intensity due to the increased body acidity at that time.

In all these investigations, an attempt was made to establish the acid or alkaline character of the symptom. Various means have been used. In suitable cases, Revici measured the local pH, i. e., cyst or joint fluid, experimental wounds, tumors, etc., and was able to confirm this dualistic pathological metabolic pattern. The spontaneous variation of the intensity of the symptom in relation to the concomitant changes of the acid-base balance of the body may also be used to establish the alkaline or acid character of the metabolic process. With this method, the alkaline pattern presents a parallelism between the curve showing the hourly variations of the intensity of the symptom, expressed as numbers from 1 to 10, and the hourly concomitant variations of the urine pH values plotted as ordinates, and the hourly intervals as abscissas. Investigated in this manner, the acid symptom will show a divergent curve, the intensity of the symptom increasing as the pH values decrease, becoming increasingly more acid. On the contrary, the intensity of the alkaline symptom will decrease as the urine becomes more acid. As the urine becomes more alkaline, the intensity of the acid symptom will decrease while the alkaline symptom becomes more severe.

These variations in the intensity of a symptom due to spontaneous changes in the acid-base balance of the body were observed also when hydrosoluble alkalinizing or acidifying substances were administered to the patients. With the use of salts such as $NaHCO_3$ (sodium bicarbonate) or NH_4Cl (ammonium chloride) in 10 to 25 grain (0.65 to 1.6 gm.) doses, the effect is shown by an increasing or decreasing intensity of the symptom, depending upon the acidic or basic character of the metabolism of the pathological tissue. The administration of oxygen, nicotinic or camphoric acid derivatives, *n*-butyl alcohol, cholesterol, glycerin, and iron decreased the intensity of alkaline symptoms and increased

the intensity of acid symptoms. Thiosulfate and fatty acids produced an opposite effect.‡

The use of these substances was helpful in studying suitable cases, so that the acidic or alkaline nature of the lesion could be quickly established and suitable therapy instituted. The response, usually rapid on administration of the above-mentioned substances, was but short-lived as a rule, and the symptom constantly reverted to the same or greater intensity after a short time. Revici's studies have shown that imbalances of the lipids with acidic or alcoholic radicals were found in these lesions. Lipids derived from both the natural or artificial sources were also found to be most active in influencing the intensity of the symptom and the character of the lesion. In particular, the conjugated unsaturated fatty acids were the most active in affecting and influencing pathological tissue containing predominantly lipids with alcoholic polar groups (i. e., sterols), while *n*-butyl alcohol or preparations of the unsaponifiable fraction of organ lipids were most active for those pathological tissues with lipids having acid groups.

Clinical conditions in the region of the head and neck associated with the symptom of pain are very frequent and are always a challenge to the otolaryngologist. If we eliminate those clinical painful syndromes encountered with associated pathological tissue changes, such as tumors and acute inflammatory processes, etc., there remains a large group of cases that can be separated into several subgroups, depending upon the characteristic distribution and nature of the pain. These are (1) vascular headaches, (2) neuralgias, and (3) unclassified headaches in which there is overlapping between the areas supplied by the blood vessels and nerves.

During my studies of various symptoms occurring in the head, neck, and chest, I believe that sufficient material was accumulated, as presented in this communication, that will serve to further confirm Revici's concept, as outlined above. The application of this concept to the problem of head and neck pain confirms the dualistic nature of the symptoms and points the way for a new therapeutic attack needed in the field of otolaryngology.

‡ References 2 and 11.

METHOD OF INVESTIGATION

Diagnosis

Every effort is made to arrive at an accurate diagnosis of the pattern of the painful symptom and to classify it according to the accepted nomenclature. Further information is sought that might be of value in identifying the acid or alkaline pattern of the symptom. If the symptom is most intense in the early morning or upon arising, it is likely to be of the acid type.[12] If the greatest intensity of the symptom is reached in the evening, an alkaline type of lesion is suspected. The relation to food intake is determined, since acid symptoms become less intense and the alkaline type of symptom becomes more intense shortly after food intake.

The curve of urinary pH in relation to the curve of the hourly variations of the intensity of the symptom is utilized for comparison whenever a suitable and cooperative patient presents. This method is time-consuming and does not lend itself well to the routine examination of the symptom. It is best performed under hospital conditions when a patient presents a symptom that varies in intensity over a period of several hours. Another difficulty with this method is the fact that it was difficult for the patient to assess the symptom intensity in terms of percentages with a degree of accuracy adequate for this method. As a rule, headaches of the vascular or neuralgic type reach a peak intensity and usually do not vary much. I have used this method occasionally in analyzing the symptom of vertigo, and refer the reader to my previous communication, in which the method is described and curves of parallelism or divergence are illustrated.

Occasionally, I have utilized the urinary pH estimation when the symptom was intense and compared it with the estimation of the pH when the patient was free of symptoms. With this short cut, an intelligent guess

may be made as to whether the nature of the symptom is either acid or alkaline.

Diagnosis of the acid or alkaline nature of the symptom can also be made according to the response of the patient to the administration of two groups of substances with opposite effects on the symptom. This procedure can be used if the patient experiences the symptom when first seen, depending on what state the lesion is thought to be in. In this instance, helpful information may be utilized from the history. When the available information indicates that the symptom is of the alkaline pattern, which in Revici's classification is called dysoxybiosis, the appropriate antidysoxybiotic substance principally used is *n*-butyl alcohol: a 7.5% solution in tap water for oral use; a 7.5% solution in isotonic sodium chloride solution for intramuscular or intravenous administration. Nikethamide (Coramine) has also been used as previously described.

On the other hand, the acid symptom is known as anoxybiotic. It often has similarities to an abnormal (chronic) healing process. In this case, appropriate antianoxybiotic substances were utilized. In this group it was sodium thiosulfate: a 10% solution in tap water for oral administration or a 4% solution in distilled water for subcutaneous use. In addition, sulfur in oil, consisting of 0.5% sublimed sulfur in vegetable oil (Wesson Oil), was used orally. Sterile ampules containing 1 cc. of the sulfur in oil were prepared for intramuscular use where the intensity of the symptom demanded more aggressive action.

When there was no basis for defining the acid or alkaline character of the symptom, the following procedure was employed. Isotonic sodium chloride solution was given by mouth, 1 to 2 cc. diluted in tap water, or 1 cc. of sterile isotonic sodium chloride solution was given subcutaneously. As a rule, the continued administration of this medication produced a negative response. If a favorable response was had with one dose, continued administration of this medication in the course of a few hours at one-half hour intervals brought a negative response. After this preliminary response, it was followed by 15 to 20 drops of nikethamide solution in tap water given by mouth or by an intramuscular injection of 1.5 cc. of nikethamide. If the patient responded favorably to this medication, the symptom was judged to be alkaline.

Treatment

Patients with alkaline symptoms were treated as follows: A 7.5% solution of *n*-butyl alcohol in water was then administered in doses of 10 to 20 drops four times a day. This was occasionally increased to 25 to 50 drops or 1 cc. four times a day. In very severe cases, 4 cc. was given every hour during the day. Occasionally, injections of *n*-butyl alcohol in 1 to 5 cc. doses intramuscularly were given when nausea was a factor and in order to more quickly influence the lesion. The regular schedule of dosage was augmented by doses every 15 to 20 minutes for five or six doses when the recurrence of symptoms in between the regular schedule demanded. This regimen of treatment was followed in the same manner as for the symptom of vertigo. Occasionally during the course of treatment, in very severe cases, an additional injection of nikethamide was given to check on the symptom, to ascertain if it was still in the alkaline phase. If the response was favorable, *n*-butyl alcohol was continued. If the symptom increased in intensity with the use of *n*-butyl alcohol or nikethamide, the symptom was considered to be of the acid type, and the initial treatment was begun with the administration of 10 to 15 drops of a 10% aqueous solution of sodium thiosulfate in water four times a day or more often. If the response was favorable, 1 drop of sulfur in oil was administered three times a day. This dose was increased gradually every day to 5 drops three or four times a day. Occasionally an increase was made to higher dosage, depending upon the dosage I thought was adequate for the particular patient in order to control the painful symptom more rapidly. This treatment was, on occasion, augmented by intramuscular injection once or twice a week of sulfur in oil in 0.5 to 1 cc. doses. Here also, as in the treatment for the

alkaline symptom, extra doses of 10% aqueous sodium thiosulfate solution in 10 to 15 drop doses every 15 to 20 minutes for five or six doses were given until the symptom was controlled. The regular schedule was then continued.

The above schedule was the mainstay of the treatment for either the alkaline or acid symptoms. When it was observed that the symptom did not recur, the regular schedule was discontinued and the patient instructed to resume the last dose when the symptom recurred. This usually served to alleviate the pain or headache. Sometimes in the course of the treatment, a trial dose of either sodium thiosulfate, a sterile 4% aqueous solution, or 1 cc. of nikethamide was given by subcutaneous injection. This was done to learn whether the symptom was still of the same pattern as at the start of the treatment. With increasing experience with the above-described method and substances, it was learned that the symptom can change while under observation and treatment from alkaline to acid or vice versa. This change was observed after a varying period of favorable response during which the symptom was under control. The symptom may suddenly recur and become worse with continued treatment. A test injection or oral administration of an opposite-acting substance indicated whether a change in the character of the symptom had taken place, as indicated by the favorable response to the administration of the second substance.

In the latter case, two additional substances developed by Revici have been used in the management of the cases. One substance, the nonsaponifiable fraction of fresh sweet butter prepared by the usual methods of lipid extraction, was administered intramuscularly in 1-cc. doses of a sterile 5% or 10% solution in oil, one to three times a week. This substance was put up in sterile 1-cc. ampules. The nonsaponifiable fraction contains sterols and higher alcohols, and in Revici's classification are lipoalcohols. The other substance consists of a mixture of conjugated fatty acids combined with sulfur. This is prepared as a sterile 5% solution in oil in 1-cc. ampules. In addition to the oral administration of the scheduled medication, this was given intramuscularly once, twice, or three times weekly for cases with acid symptoms.

These recently developed substances appeared to be more active than the substances I used in the treatment of the cases of vertigo, previously described, or in earlier cases presented in this communication. The symptom was controlled quickly with these substances, and in combination with the oral medication proved to be a very satisfactory method of treatment. The response of the patient to the injection of these substances was not as rapid as with the hydrosoluble substances mentioned earlier in this presentation. This was the general rule, but, on occasion, after the character of the symptom had been identified, I have been gratified to note a rapid response to this medication. The response occurred within three to five minutes after administration of the medication in several patients. In a certain percentage, the beneficial effect was apparent later, in some as late as one week of treatment. These substances have now become the mainstay of my treatment. The beneficial effects of Revici's method applied to the control of pathological symptoms have been confirmed in my earlier communications. Those results were obtained by the use of relatively simple substances then described. With substances obtained from sweet butter or from other natural sources, and with fatty acids combined with sulfur, I believe that the symptom has been brought under control more rapidly and more effectively.

Occasionally I have treated patients with the first less-complex substances described earlier in this article, and obtained no result after the patient had given the response indicating the substance to be used, i. e., lipoacid or lipoalcohol. After a period of the addition of the injectable substances, i. e., lipoalcohols from butter fat or lipoacids combined with sulfur, the symptoms were controlled within 24 to 48 hours.

The acid substances that were used have acid radicals in the polar groups of the polar-

nonpolar structure of the lipids. Of these acid lipids, the following acid lipid preparation was administered. It corresponds to the sulfurized conjugated fatty acids. Fatty acids obtained from cod liver oil are conjugated according to Revici's method. This consists in the use of ethyl alcohol as a solvent for the potassium hydroxide. The treatment of the mixture is prolonged for 100 hours. The conjugated fatty acids obtained in this manner are treated with sublimed sulfur, 0.5 gm. to 1000 cc. of the conjugated fatty acid mixture. This is done at 130 C for the necessary time, so that the characteristic peaks of the conjugated fatty acids seen on ultraviolet spectral analysis have disappeared.§

Diets

In addition to the above method of therapy, diets were occasionally given to the patients under investigation. Revici found in his studies on cancer in conjunction with his studies on lipids that certain articles of diet had an adverse or beneficial effect on the symptom, depending upon the acid or alkaline type of lesion and the alchoholic or acid character of the lipids that predominated in the lesion. He found that electrolytes, such as sodium or potassium compounds, had an adverse effect on alkaline pain associated with terminal cancer. Their action caused the pain to be more intense. In cancer patients with a painful lesion of acid character, the administration of sodium or potassium compounds had a temporary beneficial effect. The lipids in the food content had an especially intense effect. For example, boiled eggs, with their large content of lipids, such as cholesterol, would have a beneficial effect on an alkaline symptom. In a similar manner, salt-water fish have an opposite effect, due to their large content of highly unsaturated fatty acids. My observations have confirmed these findings in relation to cases of headache and vertigo.

Table 2.—*Diets for Patients with Head and Neck Pain*

Diet for Patients on Lipoacids (Acid Symptom)
No citrus fruit
No poached or boiled eggs
Little cream or animal fats
No liquor or other alcoholic beverages
Only small amount of sugar allowed
Diet for Patients on Lipoalcohols (Alkaline Symptom)
No fish or sea food
No liver or organs
No omelets, scrambled or fried eggs (only poached or boiled)
No chocolate
No mayonnaise
No spices
No sausage, frankfurters, bologna, table meats (Spam, etc.)

The diet was so constructed that patients being treated for an alkaline symptom would be restricted in their dietary intake of fatty acids. The sterols and cholesterols are avoided in the diets of patients being treated for an acid symptom.

For short periods of treatment, these diets are of secondary importance when the immediate objective is to control head and neck painful symptoms. When the headache or other painful symptoms are not controlled promptly, resort to these diets may become important to the treatment.

Clinical Analysis and Diagnosis

The cases were analyzed clinically in relation to the anatomic site of the pathological tissue causing the symptoms. Three categories were selected in which it was possible

§ The additional injectable substances have either an alcoholic or acid character. The alcoholic substances have a hydroxyl radical (OH) as part of the polar group of the polar-nonpolar structure. Of these substances, the following alkaline preparation was used in addition to the other substances of like characteristics mentioned earlier in this article. This substance also was added to the treatment in the latter cases of this investigation. It consists of the nonsaponifiable fraction of milk, and this fraction was obtained from sweet butter because it was easier to handle and less bulk was needed to extract the substance in sufficient quantity. Butter was saponified with potassium hydroxide and the nonsaponifiable fraction extracted with ether. After this is washed with water and dried with an anhydrous sodium sulfate, the ether is distilled off. The residue is dissolved in sesame oil, making a 10% solution. This is placed in ampules containing 1 cc. of the solution and sterilized by boiling. This is used as an intramuscular injection once, twice, or three times a week as necessary to combat the pain having an alkaline pattern.

to place the cases as they came for investigation. These were painful syndromes related to the distribution of the carotid arteries and their branches, with the associated sympathetic nerve distribution. These are commonly designated as vascular headaches. The second group comprised the various neuralgias. In this group, the pathological focus was assumed to be within the nerves or their distribution.

Diagnostic methods usually applied to cases of this type were utilized. A careful ear, nose, and throat examination was performed, and any structural changes in the head and neck that might be a competent producing cause of the painful syndrome were noted. These cases were not accepted. As a rule, no structural changes were noted to account for the syndrome. Those cases in which the distribution of pain was along the course of the carotid vessels and their branches were assigned to the vascular group. Pulsations of the temporal arteries were looked for but were not a frequent finding. However, tenderness along the carotid sheath, external maxillary and superficial temporal arteries was a common finding.

Those cases that presented scotomata were put into a separate group under the heading of ophthalmic migraine.

Where the pain symptom followed the course of distribution of the nerves involved, these cases were classified as neuralgias and were in turn diagnosed as neuritis if the pain was constant and aching in character and associated with tenderness.

As a further means of establishing the distribution and radiation of the pain, an outline of the head and neck was given the patients, and they were instructed to jot down where the pain started and to what other places it radiated. This was done by me when the patient could not cooperate and did not accurately describe the symptom.

ANALYSIS OF THE MATERIAL AND RESULTS

Ninety-seven cases of head and neck pain were taken for investigation as they presented themselves at complete random. No patient was refused except for reasons already mentioned. Two cases changed at different times and were considered as 2 additional cases, making it a total of 99 (Table 3).

Eleven cases were placed in a separate category because they showed no response to either acid or alkaline substances, although I continued to treat them for varying lengths of time until I assured myself that no response could be obtained. In my studies on vertigo, I classified this type of case as a failure, but, on further reflection, I realized that what I really was doing was confusing a series of cases showing no response with the tests used, and that could not possibly show a response, with a group of cases that were showing an active response. Therefore, from a statistical point of view, I could not include this group of cases, in which there was no probability of a response occurring, with the larger group, in which there was a probability of response.

TABLE 3.—*Response of Patients to Alkaline or Acid Lipids*

Response	Patients	
	No.	%
Positive	89	89+
Negative	10	10+
Total	99	

In reality, the preliminary tests were a screening process whereby 11 cases were eliminated from the main array and placed in a separate, although tentative, category. The grouping is considered to be tentative because in the present state of the research it is probable that the substances used are not active enough and that in the future more active substances might come forth to which some of these cases might respond, so as to be removed from this group. Generally, I believe that it is fair to say that with the tests as used today the condition of metabolic imbalance was not present, and so there could be no response. In this group there were five women and six men (Table 4). In all

TABLE 4.—*Clinical Data on Eleven Cases of Head and Neck Pain Showing No Response to Either Alkaline or Acid Substances*

Date	Case	Name	Sex	Age, Yr.	Race	Occupation	Duration	Site	Type	Treatment	Reaction	Associated Condition	Last Seen	Other Treatment
11/26/48	2	H. B.	F	47	W	Housewife	6 mo.	R. frontal	Unclassified	LB, LA	N	Neurosis	1/ 2/50	Sedation
8/27/48	6	M. F.	M	40	W	Engineer	20 yr.	Vertex	Unclassified	LB, LA	N	Neurosis	7/ 1/53	Sedation
1/26/50	20	F. M.	F	44	W	Secretary	15 yr.	R. frontal	Migraine	LB, LA	N	Neurosis	6/10/50	Ergotamine relief
7/ 8/51	32	V. M.	F	32	W	Housewife	1 wk.	R. ear	Neuralgia	LB, LA	N	Neurosis	8/15/51	Sedation
12/30/49	37	I. R.	M	21	W	Furrier	5 yr.	R. sphenopal.	Neuralgia	LB, LA	N	Neurosis	1/ 8/50	New environment
1/10/50	38	A. B.	M	64	W	Physician	15 yr.	Frontal	Migraine	LB, LA	N	Neurosis	3/ 1/50	Codeine
1/12/50	39	M. R.	M	69	W	Physician	25 yr.	R. frontal	Migraine	LB, LA	N	Neurosis	2/12/50	Ergotamine tablet, codeine
8/25/51	48	J. K.	M	52	W	Lab. tech.	3 mo.	L. cheek and face	Neuralgia	LB, LA	N	Neurosis	9/10/51	Sedation
10/25/52	59	L. B.	F	80	W	Housewife	1½ yr.	R. facial	Trig. 2-3, neuralgia	LB, LA	N	Unknown	11/17/52	Nerve section: no relief; sedation
6/ 2/53	90	P. T.	M	45	W	Lab. tech.	1 mo.	Vertex	Vascular	LB, LA	N	Unknown	6/10/51	Sedation
11/ 9/53	60	V. W.	F	65	W	Nurse	3 yr.	Trig. 11 L. 2 and 3	Neuralgia	LB, LA	N	Injury	1/15/54	Removal of torus palatinus

Cases showing no metabolic imbalance: 11, or 8%.

Note: These cases showing no metabolic imbalance were not included. They were treated although no result was expected.

LA, lipoacid; LB, lipobase.

these cases, the psychogenic factor was marked. One woman, L. B., 80 years of age, had a fifth nerve section on the right side and many other forms of medical treatment, with no result. In this group, the patients were treated with both groups of substances. Other treatments included surgery, which failed to give relief; nor did they show a response, or were their symptoms affected. The following case report is of interest because of the underlying psychogenic factor.

Four years previously, she had an operation for removal of the cervix. In June, 1948, she had an attack of Ménière's disease lasting one month. This episode was associated with ringing in the right ear, dizziness, and vomiting. She showed a 55% hearing loss in the right ear. After one month, she felt completely well, with full restoration of her hearing. She had no abnormal findings, and a neurological examination was entirely negative.

Physical Examination.—The ear, nose, and throat examination and a general physical were negative. There were no findings that could contribute any evidence as to the cause of the painful symptom.

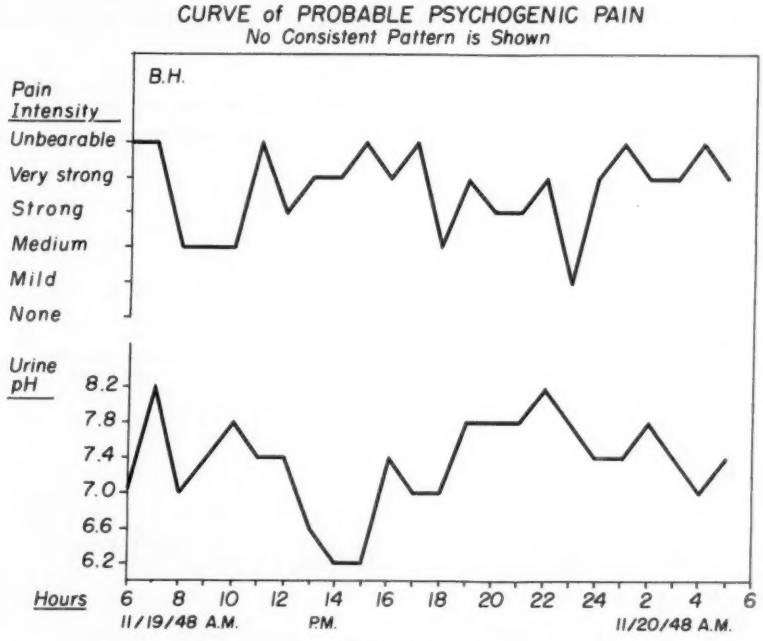


Figure 1.

REPORT OF A CASE

Studied at the Brooklyn Eye and Ear Hospital and then subjected to psychiatric survey. Followed for several years up to the present.

H. B., woman, aged 47, white, a housewife, complained of right frontal pain almost continuously for two and one-half months, was admitted to the Ear, Nose, and Throat Service at the Brooklyn Eye and Ear Hospital on Nov. 18, 1948, and was referred to me by Dr. S. Harvey. The pain started on Sept. 8, 1948, from behind the right eye and radiated to the right ear and upward to the anterior vertex area. From the last point, it radiated diffusely to the left frontal area and occasionally to the right side of the neck. In character, it varied from aching to burning. It had no relationship to food or time of day.

Laboratory data were normal. Aside from the painful complaint, the patient was very cooperative. There were no tender areas or trigger points. The external carotid nor its branches showed no tenderness. There were no symptoms in the region of the temporal vessels.

Prior to admission, the patient had various types of treatment, as follows: dextrose solution, 50%, intravenously, caffeine, ergotamine tartrate (Gynergen), morphine, acetylsalicylic acid (aspirin), procaine injections, vitamin injections, histamine, and nasal cauterization. These substances had no effect on the pain, and at times made her worse. Cocainization of the right sphenopalatine ganglion was without effect.

On Nov. 19, 1948, I subjected the patient to hourly examination of urinary pH, and she determined the

intensity of the symptom at the time the urine was collected. These determinations were continued until 5 a. m. on Nov. 20, 1948. No consistent divergence or parallelism in the 24-hour period was noted. On Nov. 23, 1948, a second series of pH determinations in relation to the varying pain intensity was run. No information was obtained as to the alkaline or acid nature of the painful symptom. Nevertheless, the patient was treated with alkaline or acid substances, without any relief of her symptom. The curve is shown in Figure 1.

Comment.—This case is presented to illustrate the information of a negative character that may be gained from a study of a pain intensity curve in relation to the changes of the urinary pH. An alkaline pattern would show a parallelism over a period of several hours, and, similarly, an acid pattern would show a divergence. Treatment with the opposite substances afforded no relief and did not make the pain worse. Both methods of investigation confirmed each other in the conclusion that there was no metabolic imbalance present. A psychogenic factor was suspected and confirmed when she was referred to another institution for a psychiatric survey. The patient has been followed to date (year 1954). Her headaches have continued, although not so severe. She repeated a course of antiallergic treatment.

The remaining 87 cases complaining of head and neck pain were investigated according to the methods previously outlined. In all of these, there was a response to the preliminary substances, either alkaline or acid, as manifested in a change in intensity of the symptom. This was usually immediate. At this point, the patient was usually observed from one to two hours, to be certain of the effect. Further treatment with the proper substances indicated that, while the symptom had decreased in intensity, a prolonged treatment indicated a probable change in the lesion itself, because after cessation of the treatment the symptom did not recur. If after a period of time the symptom did recur, a favorable outcome was had with similar treatment. In two cases, a recurrence of the symptom was associated with a change

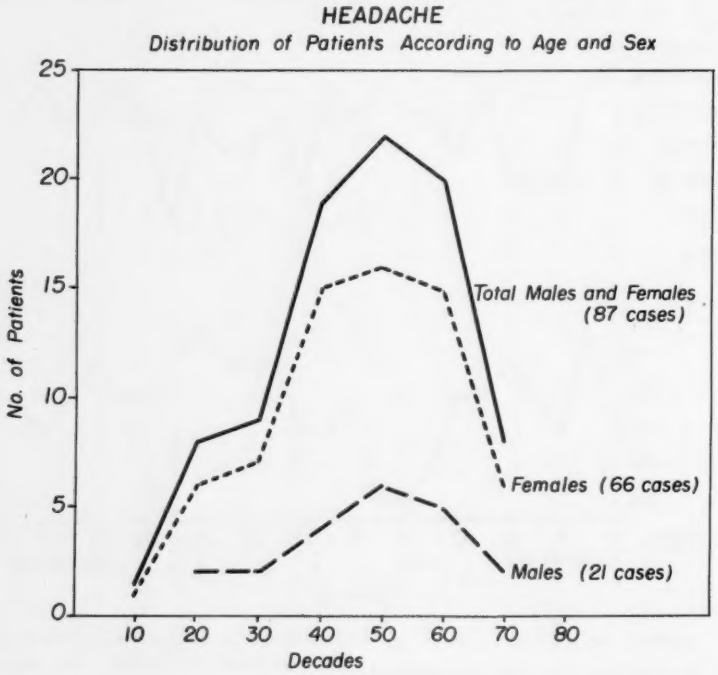


Figure 2.

TABLE 5.—*Clinical Data on Cases Showing Active Response to Treatment*

Case	Name	Date	Sex	Age, Yr.	Race	Occupation	Duration	Diagnosis	Treatment	Result	Associated Condition	Date Last Seen
1	B. G.	12/20/48	M	44	W	Operator	5 yr.	Vascular	LB, LA	Lesion change G	Vertigo	7/11/49
2	D. B.	11/20/48	F	47	W	Housewife	20 yr.	Ophth. migraine	LB, 0	G	Chest pressure	10/ 1/53
3	D. C.	3/15/48	F	35	W	Housewife	10 yr.	Unclassified	LB, 0	G	Vertigo, allergy	12/ 1/48
4	A. Fa.	12/25/47	F	70	W	Housewife	4 wk.	Auricular neuritis	LB, 0	G	Vertigo	2/ 6/48
5	A. Fl.	10/22/48	F	38	W	Housewife	1 wk.	Neuralgia, trig. 2	0, LA	G	Impacted r. molar	11/ 1/48
6	C. G.	11/ 8/48	F	19	W	Secretary	8 mo.	Vascular	0, LA	G	0	12/27/48
7	B. G.	9/29/48	F	33	W	Housewife	1 wk.	Eth. neuralgia	0, LA	G	Allergy, vertigo	10/10/48
8	R. G.	10/30/48	F	24	W	Clerk	6 mo.	Vascular	LB, 0	G	Itching, eczema	11/29/48
9	F. H.	9/24/48	F	49	W	Housewife	3 wk.	Vascular	0, LA	G	Cough	10/11/48
10	A. K.	7/21/48	M	52	W	Laborer	6 mo.	L. Eth. migraine	0, LA	G	L. neck pain	9/15/48
11	R. K.	10/27/47	F	50	W	Housewife	3 wk.	Vascular	LB, 0	G	Tinnitus, asthma	4/26/48
12	R. Ko.	8/15/48	F	18	W	Housewife	6 mo.	Vascular	0, LA	G	Dys., sacroil. d.	10/15/48
13	R. Ka.	12/ 2/48	F	65	W	Housewife	4 days	Neuralgia, r. ear	LB, 0	G	R. facial paralysis	2/21/49
14	T. K.	10/18/48	F	52	W	Housewife	6 yr.	Vascular	0, LA	G	0	3/13/49
15	R. K.	3/13/48	F	52	W	Housewife	5 mo.	Unclassified	LB, 0	G	0	7/25/49
16	T. L.	7/20/48	M	48	W	Garage attendant	1 wk.	L. ophth. migraine	0, LA	G	Backache	8/20/49
17	F. M.	1/14/50	F	26	W	Housewife	12 yr.	L. ophth. migraine	LB, 0	G	0	6/10/50
18	C. M.	12/26/48	F	24	W	Housewife	6 mo.	Unclassified	0, LA	Unsat.	0	12/ 7/49
19	H. P.	10/11/48	M	40	W	Clerk	13 yr.	Facial neuralgia	0, LA	G	Allergy, sinusitis	5/23/49
20	S. P.	10/23/48	F	22	W	Housewife	13 yr.	Neuralgia trig.	0, LA	Unsat.	0	10/30/49
21	J. P.	4/17/48	M	53	W	Laborer	3 yr.	Neuralgia, r. 5th—2	LB, LA	Lesion change G	Infected teeth	10/ 8/49
22	E. S.	11/ 8/47	F	32	W	Housewife	5 yr.	Facial neuralgia	0, LA	Unsat.	0	4/10/48
23	J. S.	11/15/48	M	11	W	School teacher	6 mo.	Supraorbital neuralgia	0, LA	G	0	11/28/48
24	M. S.	5/ 7/48	F	28	W	Housewife	8 mo.	Supraorbital neuralgia	LB, 0	G	0	11/15/48
25	J. W.	12/18/48	F	19	W	Housewife	6 mo.	Ophth. migraine	0, LA	G	0	12/24/48

26	M. T.	7/14/51	F	31	W	Clerk	6 yr.	R. supraorbital neuralgia	LB, 0	G	0	7/21/51
27	H. R.	7/16/51	M	43	W	Accountant	32 yr.	Migraine	LB, 0	G	Neurosis ?	9/ 1/52
28	S. H.	11/16/50	F	42	W	Housewife	13 yr.	Migraine	LB, 0	G	Temporal art. resection	5/18/51
29	H. G.	2/26/51	F	38	W	Housewife	13 yr.	Migraine	LB, 0	G	0	3/30/51
30	F. R.	2/17/51	F	53	W	Housewife	30 yr.	Vascular	LB, 0	G	0	6/18/51
..	.....	8/12/50	F	..	...	Housewife	.....	.....				
31	M. R.	.....	M	57	W	.....	10 yr.	Vascular	0, LA	G	Asthma	4/ 1/51
32	B. W.	1/27/49	M	50	W	Physician	5 yr.	Migraine	LB, 0	G	0	6/ 1/53
33	W. G.	8/17/49	M	39	N	Cook	8 mo.	L. sphenopal.	0, LA	G	0	10/ 2/52
34	F. K.	4/ 3/51	F	50	W	Housewife	10 yr.	Vascular	LB, 0	G	Ragweed	4/12/51
35	E. R.	3/31/51	M	54	W	Electrician	6 yr.	Vascular	0, LA	G	Arteriosclerosis	4/18/51
36	M. R.	8/27/51	F	36	W	Housewife	2 yr.	Vascular, migraine	0, LA	G	Neurosis	7/ 1/51
37	I. B.	8/20/51	M	40	W	Lab. tech.	3 days	Vascular	LB, 0	Unsat.	0	8/23/51
38	A. H.	8/11/51	M	31	W	Businessman	3 wk.	Vascular	LB, 0	G	.....	8/20/51
39	S. K.	1/28/50	F	44	W	Housewife	3 yr.	Vascular	LB, 0	G	.....	7/14/51
40	P. M.	9/12/51	M	52	W	Lab. tech.	1 yr.	Vascular	0, LA	G	.....	9/22/51
41	F. A.	9/ 5/51	F	50	N	Housewife	10 yr.	Ear neuralgia	LB, 0	G	.....	9/12/51
42	J. M.	7/ 6/51	F	52	W	Lab. tech.	5 mo.	Nose and lip neuralgia	LB, 0	Unsat.	.....	9/20/51
43	B. B.	11/29/50	F	38	W	Housewife	2 wk.	Vascular	LB, 0	Unsat.	.....	12/ 2/50
44	S. B.	10/15/49	F	19	W	Bookkeeper	2 yr.	Vascular	LB, 0	G	.....	11/12/49
45	E. B.	10/15/49	F	55	W	Housewife	15 yr.	Vascular	0, LA	G	.....	12/ 3/49
46	F. B.	7/25/49	F	40	W	Housewife	5 mo.	Neuralgia 5th	0, LA	Unsat.	.....	8/ 5/49
47	B. M.	5/16/49	M	54	W	Businessman	10 yr.	Vascular	0, LA	Unsat.	.....	9/10/49
48	F. C.	8/19/49	F	50	W	.....	5 wk.	Vascular	0, LA	Unsat.	.....	8/26/49
49	G. C.	4/25/49	F	25	W	Typist	2 wk.	Vascular	LB, 0	G	.....	5/21/49
50	C. R.	1/21/49	F	53	W	Housewife	1 mo.	L. eye glaucoma	LB, 0	G	.....	2/ 2/49
51	G. D.	12/24/51	F	19	W	School teacher	1 yr.	Ophth. migraine	LB, 0	G	....	6/ 1/52
52	G. F.	4/19/50	F	36	W	Housewife	1 yr.	Facial neuralgia	0, LA	Unsat.	.....	9/26/52
53	F. F.	1/30/52	F	54	W	Housewife	1½ yr.	Vascular	LB, 0	G	.....	5/14/52
54	C. G.	4/23/53	F	41	W	Clerk	4 mo.	Neuralgia, frontal injury	LB, 0	G	.....	5/ 1/53
55	J. G.	5/30/52	M	17	W	School teacher	13 yr.	Vascular	LB, 0	G	.....	6/12/53
56	J. G.	3/ 2/53	F	56	W	Housewife	2½ yr.	L. intraorbital neuralgia	LB, 0	Unsat.	.....	4/ 1/53
57	J. H.	10/22/51	F	32	W	Housewife	3 wk.	Vascular	LB, 0	G	.....	3/15/53

TABLE 5.—*Clinical Data on Cases Showing Active Response to Treatment—Continued*

Case	Name	Date	Sex	Age, Yr.	Race	Occupation	Duration	Diagnosis	Treatment	Result	Associated Condition	Date Last Seen
58	K. K.	11/ 5/51	F	20	W	School teacher	1½ yr.	Vascular	LB, 0	G	Chest pains	11/12/51
59	J. D.	8/15/49	M	21	W	.....	5 wk.	Vascular	0, LA	G	.....	9/18/49
60	A. B.	12/23/50	F	50	W	Housewife	1 mo.	Vascular	LB, 0	G	.....	12/30/50
61	N. K.	5/25/53	M	67	W	Furrier	7 yr.	Vascular	0, LA	G	.....	6/15/53
62	C. L.	3/23/53	F	49	W	Housewife	6 mo.	Vascular	LB, 0	G	Backache	5/26/53
63	P. W.	1/ 5/53	F	26	W	Teacher	4 wk.	Migraine	0, LA	G	.....	2/ 7/53
64	E. L.	4/25/53	F	69	W	Housewife	1 mo.	Vascular	0, LA	G	.....	5/18/53
65	E. L.	5/20/49	F	49	W	Housewife	6 mo.	Vascular	0, LA	G	.....	6/13/49
66	C. M.	2/ 9/52	F	60	W	Housewife	2 yr.	Vascular	LB, 0	G	.....	6/ 4/52
67	F. M.	4/26/52	F	32	W	Housewife	2 wk.	Vascular	LB, 0	G	.....	4/28/52
68	D. P.	9/ 3/52	F	52	W	Housewife	1½ yr.	Vascular	0, LA	G	.....	4/ 4/53
69	R. P.	10/27/52	F	56	W	Housewife	35 yr.	Vascular	LB, 0	Unsat.	.....	11/24/52
70	Ro. P.	9/22/52	F	60	W	Housewife	12 yr.	Migraine 5th and 9th	LB, 0	G	.....	11/10/52
71	G. P.	10/11/52	M	52	N	.....	3 yr.	Laryng. neuralgia	LB, 0	G	.....	12/20/52
72	G. M.	10/13/52	F	10	W	School teacher	1 yr.	Tender keloid	0, LA	G	.....	12/29/52
73	M. R.	11/21/52	F	55	W	Housewife	25 yr.	Vascular	LB, 0	Unsat.	.....	2/ 9/53
74	I. S.	5/23/53	M	47	W	Lab. tech.	1 yr.	Vascular	0, LA	Unsat.	.....	8/ 1/53
75	B. S.	3/23/53	F	63	W	Housewife	1 mo.	Vascular	LB, 0	Unsat.	.....	4/ 3/53
76	M. D.	2/20/53	F	41	W	Nurse	1 mo.	Vascular	LB, 0	G	.....	9/ 1/53
77	R. W.	1/21/53	F	65	W	Housewife	5 wk.	Trig. neuralgia	LB, 0	G	Section 5th nerve	1/26/53
78	L. W.	12/ 3/53	F	49	W	Housewife	1 mo.	Vascular	LB, 0	G	.....	12/10/53
79	A. H.	6/ 4/52	F	35	W	Housewife	1 yr.	Vascular	LB, 0	G	.....	7/16/52
80	D. A.	8/ 2/49	F	45	W	Housewife	1 yr.	Vascular	0, LA	G	.....	8/22/49
81	B. K.	2/ 9/52	M	28	W	Mechanic	1 yr.	Migraine	LB, 0	G	.....	2/29/52
82	F. F.	6/ 6/53	F	38	W	Clerk	1 yr.	Vascular	LB, 0	G	.....	8/ 8/53
83	D. F.	12/29/51	M	48	W	Taxi driver	2 yr.	Neuralgia, l. ear	LB, 0	Unsat.	.....	1/23/52
84	R. G.	7/25/53	F	66	W	Housewife	2 mo.	Neuralgia	LB, 0	G	.....	10/ 1/53
85	H. K.	6/27/53	F	38	W	Clerk	4 yr.	Neuralgia	LB, 0	G	.....	8/15/53
86	L. L.	2/13/53	M	61	W	Furrier	3 mo.	Vascular	LB, 0	G	.....	5/25/53
87	M. W.	3/20/53	F	48	W	Housewife	1 yr.	Vascular	0, LA	G	.....	6/ 6/53

LA, lipoacid; LB, lipobase.

in the character of the lesion, and the opposite substance produced a favorable result.

In this series of 87 cases, there were 66 females and 21 males. The youngest male was 11 years old, and the youngest female was 10 years of age. The ratio of females to males was 3:1 in this series. Figure 2 illustrates this phase of the data.

The array of 87 cases was analyzed clinically according to the pathogenic factors and divided into three broad groups as previously outlined. There were 43 cases classified as vascular headache, 5 cases of ophthalmic migraine, 7 cases of migraine headache, 5 cases of unclassified headache, and 27 classified as neuralgia. Table 5 shows the complete array and tabulated results.

TABLE 6.—*Classification of Patients According to Clinical Diagnosis*

Clinical Diagnosis	Patients No.	Patients %
Vascular headaches	43	49
Migraine	7	8
Ophthalmic migraine	5	6
Unclassified headaches	5	6
Neuralgias and others	27	31
Total	87	

Table 6 shows the classification according to diagnosis.

In two cases, both males, Cases 1 and 21, a change developed in the pattern of the symptom, and they were successfully treated. These were treated as two additional cases and are included in the array, bringing the total to 89 cases treated. Thirty-six cases showed an acid symptom, and 53 showed an alkaline pattern on analysis. This is shown in Table 7.

Two cases were added as additional data. The lesions changed in two males, and both were successfully treated. From this point, the array consists of 89 cases.

TABLE 7.—*Classification of Patients According to Acid or Alkaline Pattern*

Pattern of Symptom	Patients No.	Patients %
Alkaline	53	60
Acid	36	40
Total	89	

TABLE 8.—*Results of Treatment in Patients with Acid Symptoms*

Result	Patients No.	Patients %
Good	28	77
Unsatisfactory	8	22
Total	36	

The patients were treated according to the acid or alkaline pattern of their painful symptom. Those patients showing an alkaline pattern were treated with *n*-butyl alcohol, which was the mainstay of that treatment. In some of the later cases, the nonsaponifiable fraction of sweet butter was added. Patients with an acid symptom were treated with sodium thiosulfate and lipid with sulfur. In two cases, the character of the lesion changed, and these were successfully treated.

There were 36 cases in the acid group: 28 showed good results, as indicated by the nonappearance of the symptom during the period of observation, or the rapid control of the symptom when it occurred. Eight cases were judged unsatisfactory because the symptoms could not be controlled consistently. Table 8 presents these data.

TABLE 9.—*Results According to Sex in Patients with Acid Symptoms*

Results	Patients No.	Patients %
Female Patients		
Good	17	74
Unsatisfactory	6	26
Total	23	
Male Patients		
Good	11	84
Unsatisfactory	2	15
Total	13	

Table 9 shows the results in a group of 23 females and a group of 13 males who were treated and presented an acid pattern.

There were 53 males and females in the group representing a symptom with an alkaline pattern. Forty-five cases, males and

TABLE 10.—*Results of Treatment in Patients with Alkaline Symptoms*

Result	Patients	
	No.	%
Good	45	85
Unsatisfactory	8	15
Total	53	

females together, showed good results, as judged by the control of the symptoms. Eight cases gave unsatisfactory results, which are tabulated in Table 10.

The alkaline group of cases was analyzed according to sex and the results noted in Table 11.

No striking difference was noted in the alkaline group when the results for males and females were compared. There was a 10% difference in favor of the males when the results for the two sexes were compared.

The cases were then divided into clinical groups, and the results are tabulated in Table 12.

TABLE 11.—*Results According to Sex in Patients with Alkaline Symptoms*

Result	Patients	
	No.	%
Female Patients		
Good	36	85
Unsatisfactory	6	15
Total	42	
Male Patients		
Good	9	82
Unsatisfactory	2	18
Total	11	

The results in Table 12 indicate that the vascular and migraine headaches give a higher frequency of good results than are had with the group of neuralgias. However, no conclusions can be drawn as to why this would be so. Nevertheless, there is to be noted the result obtained in the migraine group, of which there are 12 cases. Five cases presented scotomata and seven cases did not. Eight cases of migraine had an acid symptom and four cases had an alkaline symptom. Good results were obtained in all 12 cases. This finding is significant in that it would indicate an active lesion that responded to the administration of either group of substances regardless of the condition of dilation or constriction of the blood vessels. Whenever this action was observed, it was considered to be secondary. However, further study in this direction is necessary with a larger group of cases.

The neuralgia group of cases was diversified within a relatively small group of 28

TABLE 12.—*Results of Treatment According to Clinical Diagnosis*

Clinical Diagnosis	Cases, No.	Results			
		Good Patients		Unsatisfactory Patients	
		No.	%	No.	%
Headaches (vascular, 44; unclassified, 5)	49	40	81	9	19
Migraine (acid, 8; alkaline, 4)	12	12	100	0	0
Neuralgias	28	21	75	7	25
Total	89	73	..	16	..

cases. The largest number occurred as trigeminal neuralgias and auricular neuralgias, of which there were 12 cases. The rest occurred as one, two, or three cases for the individual subheadings. The over-all results for the entire group, including both males and females, were 21 cases with good results and 7 cases with unsatisfactory results. These results are tabulated in Tables 13 to 15.

The cases analyzed in this communication are tabulated in Table 5. This consists of 87 cases of all types. To these I have added 20 cases of headache that were associated with the symptom of vertigo, reported in a previous communication. The results are analyzed in Table 16.

TABLE 13.—*Results According to Sex in Patients with Neuralgia*

Result	Cases		Patients			
			Male		Female	
	No.	%	No.	%	No.	%
Good	21	75	7	77	14	73
Unsatisfactory	7	25	2	23	5	27
Total	28		9		19	

In an analysis of the cases of head and neck pain, other symptoms or conditions were either volunteered by the patient or elicited on questioning. This was done in order to determine what, if any, relationship there was between the chief complaint and the associated condition or symptom. Revici and his associates have shown, in their study of the pH of wounds, that lesions such as tumor implants at a distance from the experimental wound could either elevate or depress the pH of the wound fluids, as determined by measuring the pH of the second-day wound crust. In a similar way, a symptom in a patient may be provoked which otherwise would not manifest itself by some distant but symptomatic or active lesion. In my studies on vertigo, I confirmed this observation. Abscessed teeth, asthma, etc., could provoke or intensify the symptom of vertigo. In the same manner, the symptom of headache could be provoked or intensified by some remote but silent lesion. The associated or contributory conditions are enumerated in Table 17. No generalizations can be made from the different conditions associated with the symptom, but it is important in analyzing the individual case. A list of the contributory

TABLE 14.—*Results in Neuralgia Cases According to Acid or Alkaline Pattern of the Symptom*

	Patients with Alkaline Pattern		Patients with Acid Pattern	
Result	No.	%	No.	%
Satisfactory	12	75	8	67
Unsatisfactory	4	25	4	33
Total	16		12	

TABLE 15.—*Results in Twenty-Eight Cases of Neuralgia According to Sex and Alkaline or Acid Pattern*

	Male Group				Female Group			
	Acid Pattern		Alkaline Pattern		Acid Pattern		Alkaline Pattern	
Result	No.	%	No.	%	No.	%	No.	%
Satisfactory	2	67	5	100	11	91	4	50
Unsatisfactory	1	33	0	0	1	9	4	50
Total	3		5		12		8	

TABLE 16.—*Combined Results of One Hundred Nine Cases* of Headache and Headache with Vertigo According to Acid or Alkaline Pattern*

	Patients with Acid Pattern		Patients with Alkaline Pattern	
Result	No.	%	No.	%
Good	41	85	53	86
Unsatisfactory	7	15	8	14
Total	48		61	

* The 109 cases include the 89 cases of headache reported in this paper and 20 cases of headache with vertigo reported in an earlier article.

TABLE 17.—*Contributory Conditions Found in One Hundred Cases of Head and Neck Pain*

Conditions	No. of Patients
No contributory factor	55
Vertigo	7
Neurosis (effect of anxiety, fear, guilt, etc.)	8
Chest pressure	1
Allergy	5
Impacted molar	2
Asthma	2
Eczema	1
Itching	1
Cough	1
Tinnitus	2
Dysmenorrhea	1
Sacroiliac disease	2
Facial paralysis	1
Sinusitis	1
Infected teeth	1
Resection of left temporal artery	1
Intercostal pain	1
Backache	1
Fullness in ears	1
Section of sensory root right 5th nerve	1
Ozena	1
Hypertension	1
Arteriosclerosis	1
Section of torus palatinus	1
Total	100

TABLE 18.—*Summary of Results of Treatment in 109 Cases*

	Total Patients		Male Patients		Female Patients	
Result	No.	%	No.	%	No.	%
Vascular and unclassified headaches						
Good	41	84	10	78	31	83
Unsatisfactory	8	16	3	22	5	17
Total	49		13		36	
Migraine						
Good	12	100	4	100	8	100
Unsatisfactory	0		0		0	
Total	12		4		8	
Neuralgias						
Good	21	75	7	77	14	73
Unsatisfactory	7	25	2	23	5	27
Total	28		9		19	

conditions is given in Table 17. Table 18 gives a summary of my results in a total of 109 cases.

REPORT OF CASES

CASE 1.—S. H., a 42-year-old white married woman, was seen by me on Nov. 16, 1950. She complained of left temporal and parietal headaches starting above and below the left eye, radiating to the left ear and up the left side of the head to the parietal region. In the evening, the pain would radiate to the left side of the neck along the carotid area. The pain was of intense aching character. The headache was of 20 years' duration, coming on in attacks, with short intervals of freedom from pain. The headache was associated with stuffiness of the left side of the nose and sneezing. Occasionally she had a nosebleed when the headache came on. It had no relation to food intake. The occurrence of menstruation has no effect on the headache. There were no scotomata, but blurring of vision occurred with the headache. Marked nausea, without vomiting, was frequent. The headache had been constant for two months. The family history was noncontributory.

For the last two years, she had experienced a gradual loss of vision in the left eye, which became stationary. A diagnosis of a left optic nerve tumor was made. An angiogram, pneumoencephalogram, and an electroencephalogram were negative. These examinations were done by others before I treated her. Because of the persistent headache, an excision of the left anterior temporal artery was done. This afforded her no relief. The question of allergy was investigated, but with no result. Physiotherapy, including traction treatments to the neck for her headache, afforded no relief. Other therapy included ergotamine tartrate, histamine injections, and nicotinic acid, all giving no relief. A physical examination contributed nothing that could account for the headache at the time she was seen by me. I classified the symptoms as migraine headache with a sphenopalatine neuralgic component.

She was given 1 cc. of sterile isotonic sodium chloride solution, with no relief of her symptoms. One cubic centimeter of nikethamide solution administered intramuscularly produced relief in about 15 minutes. This was followed by the oral administration of 10 drops of 7% *n*-butyl alcohol in tap water four times a day and oftener if necessary. On her next visit, on Nov. 23, 1950, the headache had been controlled, with the exception of a small area at the site of the left temporal artery excision. This pain was described as different from the main headache, but was not made worse by the medication, and was bearable. Ten drops of 50% glycerin four times a day was added to the *n*-butyl alcohol. On Dec. 1, 1950, the headache was entirely relieved. She was kept on this medication and observed every two weeks. During this time, there were occasional short periods when there was a slight return of pain, but only for short periods. She was discharged on April 18, 1951, with a supply of *n*-butyl alcohol to be taken only when the headache recurred, and to return if the headache became severe. She was not seen again. A follow-up inquiry on Nov. 11, 1952, revealed that she sought no further relief with medication. In June, 1953, further inquiry revealed no change in her status and that the headaches had become infrequent.

Comment.—It is apparent that this patient left nothing undone in her quest for relief of a headache she had endured for 20 years. The *n*-butyl alcohol helped her immediately, and the good effect was maintained for the period of observation. A psychogenic factor, that is so continuously associated with these syndromes, could not be elicited in this case, although the diagnosis of an optic nerve tumor created an atmosphere of anxiety and apprehension that intensified the headache for the two to three months prior to my seeing her. This was an early case, and *n*-butyl alcohol gave sustained relief. In the later cases, the nonsaponifiable fraction of butter was used in this treatment.

CASE 2.—B. H., white man, aged 43, whose occupation was that of real estate appraiser, was seen by me on July 16, 1951. The complaint was migraine headache on the left side of the head on and off for 32 years. The attacks always occurred on the left side, with an extremely tender spot in the region of the distal distribution of the left anterior temporal artery. From there, it radiated to the left eye, ear, and back of the head. Occasionally there was tingling of the fingers of the left hand and arm. Photophobia and nausea were present with the attacks, and, on occasion, he noted that the blood vessels of the forehead were prominent on the side of the headache. The headache came on suddenly, with no premonitary symptoms, and reached its greatest intensity either in the morning or evening, and this varied during the attack. The attack always occurred on the left side and only once occurred on the right. These attacks usually lasted from four to six weeks, and the last attack lasted 10 weeks. Ergotamine tartrate and ergotamine with caffeine (Cafergot) helped give him relief for 10 years, but in the last 20 years he has found no relief from the usual drugs. He constantly carries with him barbiturates, codeine sulfate, ergotamine with caffeine, ergotamine tartrate, and acetylsalicylic acid. Histamine offered no relief. He carries on his work as an appraiser despite the pain, but this has now become unbearable.

The physical examination and past history were noncontributory.

The patient was given 1 cc. of 4% sterile sodium thiosulfate solution subcutaneously, and the headache increased in intensity. Nikethamide solution, 1.5 cc., relieved the headache 20 minutes thereafter, and the improvement was increased with the oral addition of 25 drops of 7.5% *n*-butyl alcohol diluted with water. He was given the diet for lipobase and instructed to take 7.5% *n*-butyl alcohol in water four times a day and more often to control the symptoms. On July 20, 1951, he reported that the headaches recurred but were relieved by additional medication. No other medication was given. During the period of the headache's greatest intensity, the urinary pH was 4.6 to 5.6 and the surface tension, as measured by the Revici Urotensiometer, was 65 and 63 dynes/cm. (normal: 68 dynes/cm.). On July 28, 1951, he had only occasional fleeting attacks of headache of low intensity, which were consistently relieved by the medication. On Sept. 17, 1951, he was entirely free of headaches. His urinary pH was 7.0 and the surface tension was 69. He was discharged and told to take the medication only when the headache recurred.

Comment.—This illustrates a case of migraine headache of many years' duration, which had ultimately failed to attain relief by the usual medications. As in most cases of this kind, a psychogenic factor was present, but this was not investigated. When contacted a year later, he stated that the headaches did not recur. He was then starting psychiatric therapy. He was again checked on June 10, 1954, and his headaches had not recurred since he had been treated by me.

Case 3.—P. R., white woman, aged 60, was first seen by me on Dec. 18, 1946. Her complaint was an aching pain of unvarying intensity, which reached a high level two weeks after the onset. The pain started in a trigger area at the base of the left side of the tongue adjacent to the tonsillar area, and radiated over that side of the pharynx and down the left side of the neck. Another trigger area over the ala of the left nostril initiated the pain which radiated in the distribution of the second division of the left fifth nerve. The causes of the onset were unknown, but the chewing of food was the usual way that the pain was initiated in the glossopharyngeal area, and rubbing of the cheek would initiate the pain in the trigeminal area. Because of this condition, the patient had all of her remaining teeth extracted some years prior to her visit, but without relief. Other medications also gave no relief.

During the first three years the pain would recur every three months after the onset and last about one week. From 1943 to 1946, the attacks lasted a bit longer, and the last attack had been present for over a month.

The physical examination was noncontributory.

I injected the left second division of the fifth nerve in the region of the foramen rotundum at the base of the skull, and the left glossopharyngeal area at the base of the tongue and tonsil with 1% procaine. This afforded the patient immediate relief. I did not see the patient again until Sept. 22, 1952, six years later. At that time, she experienced an attack that had lasted one month. No medical treatment was of help. The pain had the same distribution as when she was seen six years earlier but came on every 15 to 30 seconds, associated with flashes of light in her left eye and spasms of the left facial muscles. The pain had a burning character. Irritation of the trigger areas by eating or pressure brought on the painful spasm. The pain immediately reached a peak intensity after the onset, and this continued day and night for two weeks. Physical examination and appropriate neurologic tests did not reveal any organic cause. There were no areas of anesthesia. Pressure over the left cheek brought on the pain.

The administration of nikethamide solution intramuscularly was followed by slight relief in 20 minutes. This was followed by an intramuscular injection of 7% *n*-butyl alcohol in isotonic sodium chloride solution. The pain was about a third relieved. This was again followed by an injection of 1 cc. of the nonsaponifiable fraction of sweet butter in a 10% solution in sesame oil. This was followed by about 75% relief in about 15 minutes. She was given 25 drops of a 7.5% solution of *n*-butyl alcohol in tap water four times a day and oftener as necessary. On Sept. 24, 1952, the pain returned, and she received another injection of the nonsaponifiable fraction of sweet butter, with practically complete relief of pain in 15 minutes. She received these injections two to three times a week for a total of 11 injections. This completely relieved her pain. She was last seen on Oct. 30, 1952.

Comment.—This case illustrates a very severe type of neuralgia involving the second division of the fifth nerve and the glossopharyngeal nerve with some vascular components. For 12 years, this patient sought relief and failed to obtain it. Recourse to operative intervention for relief would have been a logical and reasonable next course. During this period of observation, she obtained complete relief. This case is also presented because it illustrates the effect of the

more complex lipids of a sterol nature that Revici has developed. A beneficial result could apparently not have been obtained with *n*-butyl alcohol alone, by either mouth or injection.

CASE 4.—L. J., a white man, aged 48, was first seen by me on July 20, 1948. He complained of a low back pain for two months. Repeated examinations did not account for the symptom. His physician had given him various analgesics and physiotherapy, but these treatments did not help him. Heat applied to the back and hot baths offered a modest measure of relief. In the belief that the symptom was inflammatory in origin, he was given 25 drops of 7% *n*-butyl alcohol in an aqueous solution orally every 15 minutes for four doses. At the end of one hour, his backache was relieved. He was given 25 drops of 7% *n*-butyl alcohol in an aqueous solution four times a day. On July 23, 1948, the pain was completely relieved. He occasionally took 25 drops of *n*-butyl alcohol for about two weeks thereafter, and the backache did not return. On Sept. 17, 1948, he returned complaining of a severe left-sided headache that started in the left temporal area above the left eye and radiated toward the left parietal area, lasting one week. The left temporal area was pulsating and tender. He had taken the 7% solution of *n*-butyl alcohol in doses of 25 drops, and this had increased the pain so that it became unbearable. He had taken ergotamine tartrate, acetylsalicylic acid, morphine, and codeine sulfate, without relief. He was given 10 drops of a 10% solution of sodium thiosulfate in water four times a day on Sept. 18, 1948. This eased the headache, and on Sept. 20, 1948, sulfur in oil was added, 1 drop three times a day. On Sept. 21, 1948, he had complete relief. After this, the head pain recurred in mild form in the morning hours as an uncomfortable sensation, rather than as a pain. The sulfur in oil was increased to 3 drops three times a day, and a 10% sodium thiosulfate solution was continued. On Sept. 29, 1948, complete freedom from pain was noted, also no pulsations in the left temporal area, and no tenderness. He was checked on Jan. 7, 1949, and on Aug. 20, 1950, with the report that there was no return of the headaches.

Comment.—This case is of interest because of two symptoms occurring in the same person on two different occasions, with two different patterns. The first was alkaline and the second, acid. Each time, the usual methods of treatment were instituted, but without success. Treatment with the appropriate lipids was successful. At this point, I may mention that symptoms often can coexist, such as headache and asthma, supraorbital neuralgia and intercurrent vascular headache. Treatment of one with the appropriate lipid may make the other worse. Here it becomes a matter of treating the major symptom with the appropriate lipid and treating the other with the usual available methods. On the other hand, the treatment with the appropriate lipid of one symptom may favorably influence the other, both symptoms being of the same character, acid or alkaline.

CASE 5.—M. G., aged 10, a white girl, was operated upon by me for a thyroglossal sinus on Oct. 16, 1951. This had started as a thyroglossal cyst shortly after birth, later becoming infected. This necessitated an incision for the evacuation of an abscess, and the resulting sinus continued to drain until operative relief was given. The postoperative recovery was uneventful, and she was discharged on Nov. 17, 1951, with a well-healed and dry wound.

She returned on Oct. 13, 1952, complaining of pain in the operative scar on and off since her discharge from my care, but in the past month, it had been almost continuous. The usual analgesics and anesthetic ointments afforded the child no relief. Examination revealed a child obviously distressed because of the painful symptom. She presented a keloid scar, 1½ in. (3.5 cm.) long, at the hyoid level and occupying the postoperative site. The scar had an undulating surface, was red, tender to touch, and had a water-logged appearance. The edges were chalky white.

Revici has pointed out that the pain pattern in the later stages of healing is often of an acid or anoxybiotic character. She was given 1 cc. of a 4% sterile sodium thiosulfate solution subcutaneously, and the pain was relieved within 10 minutes. She was given 10 drops of 10% sodium thiosulfate solution four times a day and 1 drop of sulfur in oil three times a day orally. This dosage effectively controlled the pain until Oct. 20, 1952, when she returned, stating that the pain recurred from time to time but was much less intense. There was less swelling of the scar and only slight tenderness. She was given an injection of 0.25 cc. of the conjugated fatty acid in oil, and the oral medication continued without change. From Oct. 27, 1952, at weekly intervals, until Dec. 29, 1952, the injections were increased so that the last injection consisted of 0.5 cc. of the conjugated fatty acid. The sulfur in oil was likewise increased until she was receiving 4 drops three times a day. The 10% sodium thiosulfate solution was continued at 10 drops four times a day. By the end of three weeks, all pain and tenderness from the keloid scar had disappeared.

At her discharge on Oct. 29, 1952, the scar was harder and had a white border. The water-logged appearance had disappeared. She was told to continue the oral medication for a month. On April 28, 1954, a check-up showed that there was no return of the pain or tenderness, and the scar was now pink in the center with a white border, and harder.

Comments.—This case is presented because tender hypertrophic scars usually designated as keloids present a problem in pain control, and, further, this case also illustrates a visible structural change associated with a painful symptom. The pain was easily controlled, and, at the same time, there was visible evidence of a structural change that

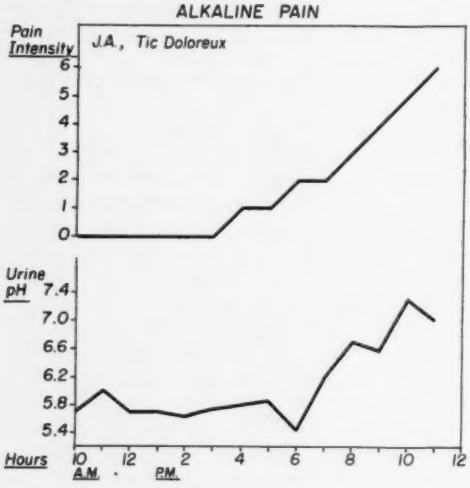


Figure 3.

could probably be associated with the role of lipid medication. The symptom was associated with a structural change, and an exception was made in this case by including it. This was not the rule in this series.

Case 6.—This case of major trigeminal neuralgia is of interest because the pain curve illustrates the character of the evolution of the intensity of the painful symptom. From a zone of no pain of five hours' duration, it reached an intensity of 35% in another four hours. This was tolerable to the patient. Four hours later, it had reached an unbearable intensity of almost 100% value. This part of the curve rises upward in a straight line to the right. The four hours that it took to reach 35% value was a gradual step-like curve. When this curve was plotted against the hourly variations in urinary pH, the curve for the pH was high on the alkaline side when the pain reached its greatest intensity. The colorimetric values of the urinary pH are given (Fig. 3).

J. A., a white man, aged 45, was first seen on April 17, 1950. In May, 1949, he first began to experience pain on the right side of the face. There was a trigger zone in the right upper lip, which caused a severe sharp pain in the right side of the face, radiating especially to the eye and forehead on pressure. Because of the intensity of the pain, it was often necessary for him to lie down. This pain became more pronounced as the day wore on and toward evening, when the patient was tired. In the morning, direct pressure might or might not cause the attack. By late afternoon or evening, talking or eating, with consequent motion of lips, might produce an attack.

Physical Examination.—Patient was apparently in good health. There was a suggestion of a right facial paralysis, with slight flattening of the right nasolabial fold and a slightly greater arch to the upper lip on the right side than on the left (spasm). Pulling on the right side of the mouth produced sudden mild pain. B.P. 140/90. Heart and lungs negative. There were no contributory findings.

May 1, 1950.—On *n*-butyl alcohol, 7% aqueous solution, 10 drops four times a day and every hour in the evening. Patient stated that there was relief from pain after five minutes of taking the medication. The relief was not total in the sense that there was still some hypersensitivity to touch, although this, too, was less. Similarly, pain related to motion of the mouth was completely relieved after taking the medication. Patient told to take 10 drops only for pain, spontaneous or induced by motion of the mouth.

May 22, 1950.—Patient stated that his symptoms were very much relieved. They were still most prominent toward evening; however, most days pain was not sufficient to disturb him and was only present on direct firm pressure. During the past, pain was of sufficient intensity (50% of pretreatment on only two occasions) to cause him to take medication. Pain was relieved completely except on firm pressure to trigger area. Patient stated that most of the time pain was 90% less than during pretreatment period, and was readily reduced by a single dose of 15 drops. He was advised to begin to take the medication regularly in order to attempt complete control of the symptom.

COMMENT

The problems that must be solved in the successful treatment of the different types of head and neck pain are many and varied.

One of these problems that calls for solution is to alleviate the painful symptoms as quickly as possible so that other necessary therapeutic measures may be expedited, i. e., psychotherapy, correction of structural changes, etc. I approached the problem from the clinical level but according to the physiopathological aspect as outlined earlier in this article. I sought to determine whether with this approach, utilizing the substances described earlier, I could relieve the symptoms of head and neck pain. Any clinical approach to the problem of pain that furthers our knowledge about it and helps in our ability to control it is very important, and so this presentation is given from this point of view. In order to clarify the clinical data, the physiopathological aspect has been outlined and related to them.

The results herein reported are related to the control of the painful symptom during the period of observation. During this period, I reported what I considered an acceptable result and the ones I considered unsatisfactory. Recurrences did take place, and some of these patients were again treated successfully. Others followed had recurrences and did nothing about it, while others claimed that the pain did not recur and remained permanently controlled. Some claimed that the recurrences were less intense and less frequent and controlled by simple sedation, i. e., acetylsalicylic acid. Further studies in this direction, with adequate follow-up studies, will be necessary in order to definitely evaluate this aspect of the problem.

The clinical aspects of head and neck pain are varied. Many different factors were thought to be the bases for the interpretation of the differences that were encountered clinically. Various hypotheses concerning the etiology, pathogenesis, and location were advanced in order to explain these differences. Most studies have led to the recognition of different etiological factors that determine these painful states. Trauma, infection, benign and malignant formations, allergy, and vitamin deficiencies are the most accepted causes determining these painful syndromes. In most of the cases, no etiological factor could be recognized at the clinical level. It is logical to think that upon the resolution of these aspects of the etiologic problem specific means of control would be available, but because of the multiple factors involved, and the difficulty in establishing the etiological factor, therapeutic approaches based on it presented almost insurmountable difficulties. Because of the remote possibility of such a definitive solution of the problem, a less specific approach was desirable. By a consideration of the mechanism with the biochemical changes which occur, leading to the appearance of pain, a simpler, less specific approach was attained.

These considerations reduced the problem of many etiologic factors as well as the processes, i. e., vasoconstriction, vasodilation, edema, autonomic unbalance, to that of two biochemical fundamental changes. The theoretic therapeutic approach, predicated upon the last concept, led to an advance in the practical solution of these problems. The pluralities of these mechanisms, the difficulties attendant to the recognition, and the fact that the clinical results obtained through them are still far from satisfactory have impelled me to investigate the above-mentioned approach as a more basic attack of the problem, utilizing the dual pattern of their pathogenesis. While the biochemical changes in these two patterns and the symptoms and signs associated with them could be systematized for each one, this physiopathological concept could be followed in the study of the pharmacodynamics of the agents used in therapy, also. Consequently, it represents a basis for a new approach in this important branch of medicine. Dualistic changes in the constitution of the cell, physiopathology, and therapy (pharmacodynamics of the agents employed) related this concept to the action of lipids with opposite physicochemical characteristics. In this way, biology is associated to the fundamental concept of dual processes taking place in the constitution of the cells, the two types of processes being further related to the anabolic and catabolic activities.

In the studies of normal and pathological conditions, Revici ‖ emphasizes the operation of two relatively separated systems: one, the hydrosoluble, and the other, the liposoluble. This latter system is related to the intervention of the body lipids. The intervention of these liposoluble substances in pathology is particularly seen through the action of the "abnormal" unsaturated fatty acids and sterols, with their localization at the level of the pathological foci. The characteristics of this system relate it especially to the organization of the cell membrane and the processes of permeability. In each one of these systems, similar processes, such as oxidation-reduction processes, have differences according to the system in which they take place. With their different roles in the biology of cells, the effects of their activity will lead to different end-results. These considerations led Revici to the study of the lipids as a separate group of the cell constituents. The study of their changes represents a new approach to biological investigation and, especially, for pathology and therapeutics. The concept of homeostasis of Cannon ¶ acquires a more extended significance from this new point of view. The relationship between the two systems in a measure clarifies the type of condition which their abnormal actions produce through the character of the reaction of their components.

The characteristic of the reactions in which the liposoluble system is involved is their slow evolution.# They are "time reactions" and the changes are relatively small, in opposition to the rapid and intense reactions of the hydrosoluble system. According to Revici, the oxidation-reduction processes, for instance, take place at the nonpolar group of liposides in the liposoluble system. In the hydrosoluble system, these processes usually take place at the polar groupings. This explains the fact that the abnormal foci induced through the activity of the liposoluble system are generally related to chronic recurring conditions. Because of these characteristics, biological processes acquire the proper aspect when occurring in the liposoluble system. The changes in the nature of the lipids involved induce profound modifications in the cell metabolism through their role in the function of the cellular membrane. These changes could be catalogued as taking place in two opposite directions. A dual abnormal metabolism results: one leading to the liberation of acid and the other to alkaline substances. This represents a basic or fundamental separation of pathological processes. The application of this concept to medicine presents three aspects: (1) physiopathology, (2) diagnosis of the pattern, and (3) treatment.

Two reasons impelled me to undertake this investigation. As a clinician, I was naturally interested in a new approach to the problems involved in the treatment of patients who seek the otolaryngologist to obtain relief of painful conditions of the head and neck. The second reason is that an investigation of this type affords a good opportunity to gain a better understanding of the mechanisms involved in the production of pain and the application of such knowledge to its treatment.

As indicated in Table 1, the etiological factors that may be active in cases of head and neck pain are many and varied. In almost all the cases, no etiological factor could be recognized at the clinical level. It is logical to think that with the solution of the etiological problem specific means of control would be available, but, because of the many factors involved, establishing the etiological factor in practice very often presents insurmountable obstacles. A therapeutic approach based upon a knowledge of the exact etiological factor is usually impossible.

For this reason, a less specific approach has certain attractive features. As further indicated in Table 1, any or all of these etiological factors may lead to neurovegetative or vasomotor disturbances as well as to lesions of the nervous tissues. These involve, and the etiological factors are all capable of producing cellular and pericellular metabolic

‖ Revici, E.: Personal communication to the author.

¶ References 5, 13, and 14. Overton, cited by Höber and others.[15]

Revici, E.: Personal communication to the author.

disturbances, which thus constitute a common denominator. As indicated further in Table 1, these cellular or pericellular disturbances are divided into two fundamental basic biochemical changes. A therapeutic approach predicated upon this concept has led to a practical advance in the solution of these problems. This would not be possible if therapy were to be based upon etiological factors alone. The pathogenesis of pain can be seen as involving two distinct mechanisms. In one, acid pain is caused by a cellular or pericellular disturbance in which the abnormal metabolic processes bring about a local acidosis. Alkaline pain, on the other hand, is caused by disturbances in which the abnormal metabolic process leads to a local alkalosis.

According to Revici, two relatively distinct biochemical systems operate in the body. One of these is a hydrosoluble system, the other is a liposoluble one. In pathological foci, the intervention of the liposoluble system is evident through the action of "abnormal" unsaturated fatty acids and sterols. Since these liposoluble substances are related especially to the cell membrane, disturbances in this system profoundly influence cell permeability.

Although similar reactions take place within the hydrosoluble and liposoluble systems, they lead to different end-results. The reactions of both systems are concerned with maintaining the homeostasis of the body. Those in which the liposoluble system is involved are slower in their evolution. They are "time reactions" and the changes are relatively small, as compared with the rapid and intense reactions of the hydrosoluble system. According to Revici, this accounts for the greater importance of the liposoluble system in pathological conditions that are chronic and recurrent in character. For these reasons, it is essential to consider the changes in the nature of the lipids involved in the profound modification of cell metabolism that occurs in pathological tissue. These changes are especially manifested in the cell membrane. A dual abnormal metabolism results because of the lipid imbalance that may lead to a predominance of either sterols or fatty acids. This imbalance may express itself as a functional disturbance (metabolic imbalance), and remain without structural changes. At other times, it is associated with structural changes, such as trauma, tumors, etc.

Revici has shown that in those pathological lesions in which sterols predominate, the abnormal cellular metabolism leads to the production of a local acidosis and an acid type of pain. On the other hand, a predominance of fatty acid leads to a local alkalosis and alkaline pain. This concept has important applications in understanding the physiopathology of an abnormal lesion, determining the pattern of the pain or symptoms, and establishing a suitable therapeutic approach.

In my earlier publications concerning postoperative wounds and vertigo, I have outlined this dualistic concept. According to this dualistic concept, two patterns are present, involving all the metabolic processes in a cell. The changes in cell-membrane permeability have shown the existence of not only a quantitative increase but also an alteration in the selection of the material passing through the membrane. The alteration can lead to the penetration of different substances from the intercellular fluid into the cells or, on the contrary, to nonadmission of certain necessary materials to the cell. The abnormal oxidation-reduction processes show similar qualitative deviations in the sense that processes with abnormally high or low potentials take place. The metabolism of carbohydrates, proteins, and fats is thus qualitatively forced into two opposite directions. Abnormal products appearing as elaborated by the abnormal cellular metabolism can also be related to the dualistic character of the processes. Although the fundamental abnormal patterns can be reduced to this dualistic concept, the substances that result are multiple, involving the various metabolites which take part in the physiology of the cell. The predominance of one or the other of these substances from the same group give

the secondary characteristics of the fundamental dual process. This plurality of the processes under the same fundamental abnormal pattern explains the variety of the aspects under which these patterns can appear in the clinic. From the pathogenic point of view, the intervention of lipids of two opposite physicochemical characteristics makes the solution of the problem simpler. But here, too, the intervention of various abnormal fatty acids for one group, or various sterols for the other group, gave certain characteristics of specificity in the sphere of each of these patterns.

An approach at the level of lipid therapy in these processes thus has the advantage of the use of highly nonspecific agents active in almost an entire group of symptoms corresponding to one or the other of the patterns. For more specificity, the search has to be directed toward the same group. This aspect of the investigation also throws a new light on the pharmacological problems involved. Revici has shown that by changing certain substances in one group or the other changes in the effectiveness of the medications were observed. It is to be emphasized that the results were noted only as a greater or lesser intensity of the effect, which corresponds to the above-mentioned concept of a secondary activity of the different substances.

This approach to the problem of head and neck pain in this light has been very instructive. The study of the symptoms, their relationship to other biological changes (acid-base balance; other associated abnormal foci), and the response to the various substances with a known activity based on the concept of dualism have confirmed the hypothesis of a dualism in their pathogenesis. The antagonistic response of the same symptom to various substances which have opposite actions, according to this concept, was additional confirmation of this hypothesis. The therapeutic approach based on this concept has brought me to realize that changes had occurred that could be related to the above-mentioned mechanism. The use of placebos and, especially, the induction of an opposite effect through substances from the opposite groups have practically eliminated the hypothesis of a psychic factor where that was thought to be a factor as a cause of the effect obtained.

The fact that definitive results were obtained in cases assumed to be without morphological or visible changes led me to believe that the pathogenesis of the pathological condition could be sought at the cellular level and limited to functional changes which, with the means at our command today, cannot be detected as a structural change. This put the problem of the psychogenic factor in a new light. Without discussing here the possibility of hormonal intervention or other factors in the pathogenesis of these conditions, it must be admitted that the response of these conditions thought to be purely psychogenic in origin, to the therapy utilized above, indicates a metabolic factor present at the cellular level. The part played by vasomotor activity in the production of these changes is an accepted one, and circulatory impairment produced by vasoconstriction and vasodilation can induce changes in the biochemical constitution of the cell with associated abnormal metabolic processes. However, I believe that this is a secondary effect and related only to the intensity of the symptom which these actions can induce via the small changes that take place locally in the acid-base balance, either physiologically, i. e., food intake, or influenced by severe emotional stress. For this reason, the "purely functional disturbances" associated with vasomotor circulatory disturbances or the increased capillary permeability, autonomic imbalance, are reduced to the same dual metabolic pattern. The results obtained through the application of the above concept were followed for more than momentary relief. It was my intention to try to modify the abnormal changes in the metabolic process at the point which corresponds to a more fundamental level. This objective is attainable at the cellular level through a change in the lipid constitution of the cell. Treatment aimed at the intercellular fluid in an endeavor to modify the elaborated sub-

stances of the abnormal cellular metabolism that accumulate there and influence the pH to the acid or alkaline side produces a prompt but transient effect. This effect would also be transient if the treatment were directed to influence the permeability of the cell at the so-called functional level. For long-range effects that offer a possibility of restoration of fatty acid-sterol balance in the cell, and thus alleviate the symptom, lipid therapy must be ultimately administered.

It will be observed from the aforementioned remarks concerning the physiopathological approach to the problem of head and neck pain that Revici has made a practical correlation between the lipid metabolism, particularly the unsaturated fatty acids, and the acid-base balance of the body. Small changes in the local pH at the site of the abnormal foci in the intercellular fluid caused by elaborated substances from those cells initiate and influence the symptom intensity at the nerve endings in this vicinity. We have here at our disposal an adequate explanation of a mechanism, a means for diagnosis of the alkaline or acid character of the symptoms, and an efficient tool for attack, namely, lipid therapy. The therapeutic approach is at a more fundamental level, the level of the lipids of the cell. The therapy is easily instituted, and the substances used are quick-acting and nontoxic.

Historically, Revici's studies can be related to the early work of Overton,* who studied many substances in relation to cell permeability, and Cannon's study on homeostasis. In "The Wisdom of the Body," Cannon states [13]:

> The coordinated physiological processes which maintain most of the steady states in the organism are so complex and so peculiar to living beings, involving as they may the brain and nerves, the heart, lungs, kidneys and spleen, all working cooperatively, that I have suggested a special designation for these states, homeostasis. The word does not imply something set and immovable, a stagnation. It means a condition which may vary but which is relatively constant.

In a later chapter, he adds,

> When we have learned more concerning the factors which govern the constancy of proteins, fat and calcium in the blood plasma, we shall probably see that it results from such devices as those operating in the better known cases of homeostasis.

These studies [14] generally concerned themselves with general changes that occurred in the various constituents of the body: adrenaline formation, blood clotting, etc. Revici has shown that these changes can be of a local character, such as a local acidosis or alkalosis, making small changes in the pH of the intercellular fluid, and he connected these changes with the mechanism of pain causation through the products of metabolic imbalance in the lesion itself. Here the lipids, unsaturated fatty acids, and sterols, as Revici has shown through his studies, are modified in the body and in some unknown way induce the pathological lesion. This mechanism can be of value in explaining remissions in disease processes that cannot adequately be explained by invoking the mechanism of changes in the hydrosoluble system of the body alone. The use of appropriate lipids administered to the patient by mouth or injection naturally follows as a logical procedure as a means of influencing the pathological focus.

These remarks are predicated on experimental data accumulated by Revici [17] and his associates. The data presented in their studies concern the new systematization of polar-nonpolar substances that should influence our thinking about our current views on lipids. The measurement [11] of the pH of experimentally produced wounds as a method for the study of abnormal foci shows how various substances can elevate or depress the pH of a wound, and the effect of distant abnormal foci on the wound offers an explanation of the effect of one spontaneously occurring pathological focus on another in the same patient. The correlation between the pH of urine and blood, titrimetric alkalinity,† offers an explanation for the varia-

* Overton, cited by Höber, and others.[15] Reference 16.

† References 12 and 18.

tions in symptom intensity and variations of the pH of the urine.

The relationship of current remedies utilized successfully in the attack on head and neck pain to Revici's hypothesis, in which the use of lipids plays a dominant role, has naturally attracted my attention. I have previously referred to the effect of hydrosoluble acid or alkaline substances acting largely upon the acid-base system, and to their ability to elevate or depress the local pH of the lesion. At the clinical level, the effects of various water-soluble substances on the intensity of a symptom were interesting. Two substances attracted my attention and have been utilized in the latter part of this series of cases, and in recent but unreported cases of vertigo. Prior to these investigations, I had used preparations of ergot for the relief of headache and vertigo successfully, but had never been convinced that the mechanism of their action was adequately explained. The older preparation, ergotamine tartrate, having a marked constrictor effect, could be related to the visual observation of the dilation of the temporal arteries in a case of migraine headache. It is believed that reduction of the amplitude of pulsations of branches of the external carotid artery, as would occur with a constrictor drug, was the factor that was related to the formation of the headache intensity. However, when this same drug had a favorable effect on the reduction of the intensity of vertigo, the explanation was not clear. In this instance, the evidence in favor of dilation or constriction of the branches of the internal auditory artery and its vestibular distribution was not visible, and the condition of pathologic vasodilation or constriction could only be inferred.

The additional concepts, as stated above, I believe, add information to the already accepted pharmacologic actions of certain ergot derivatives. These concepts point to an additional pathway for further investigation, so that, in addition to the specific known activities of drugs, other actions as yet unknown must be considered. The relationship with the activities of lipids, as shown above, represents a new pathway for this interpretation of the pharmacodynamics of these substances.

The alleged activity of the recent ergot derivatives is clearly explained in the literature. In addition, dihydroergotamine (D. H. E. 45) has also been used in the treatment of herpes zoster. Dihydroergocormine methanesulfonate, dihydroergocristine methanesulfonate, and dihydroergocryptine methanesulfonate (Hydergin) have been used in peripheral vascular disease, hypertension, and geriatric problems, as well as in vertigo (Anderson and Rubin).

The apparent broad indications for the use of these two drugs and their opposite effects lead to the thought that a secondary but very important activity takes place. Through the analysis of their effects, parallel to those effects obtained in the cases through the action of lipids, I have tried to interpret this secondary effect as resulting from a similar mechanism, as put forth by Revici as taking place at the lesion itself, and not through vascular channels.

The two recent preparations of ergot ‡ that I have utilized are dihydroergotamine and Hydergin. They may be given intramuscularly or intravenously. Hydergin is also available in tablet form, to be given by mouth. In my clinical investigation, I noticed that dihydroergotamine acted similarly to lipids with alcoholic polar groups. The action of Hydergin, while not so clear, acted similarly to lipids with acid polar groups. These newer ergot derivatives have lost the property of vascular constriction, and have become vasodilators through the process of hydrogenation in their manufacture. This action is now mediated through the action of the drugs on the central nervous system, with an increase of the blocking effect to sympathetic nerve stimulation. Both drugs show a loss of ability to stimulate smooth muscle. The only exception is that dihydroergotamine is considered to have a very mild constrictor effect on

‡ References 19 and 24.

the peripheral vessels, as shown by the fact that "experimental gangrene in the rat's tail and the cock's comb was far more difficult to produce by administration of D. H. E. 45 than by the administration of the ergotamine tartrate." [21] Thus with the elimination of the vasoconstrictor effects of these recent products of ergot through hydrogenation, it becomes difficult to relate the relief obtained in headache and vertigo to this action. On the other hand, the substances originated by Revici, both lipids and hydrosoluble substances that I have presented in this communication, are devoid of any other action, i. e., vasoconstriction or vasodilation, that would indicate that their beneficial or adverse effects were related to this mechanism. As indicated earlier, these effects on pain and vertigo can be related to the change in the local pH at the site of the lesion, indicating an effect on the abnormal metabolism of the pathological focus. From this point of view, the effects of these drugs on the abnormal metabolic focus must be seriously considered, and our current views on the control of headache and vertigo, as to the actual mechanisms involved, revised. While the effects through vasoconstriction and vasodilation are recognized, I must consider them as secondary.

Dihydroergotamine produced a beneficial effect on an alkaline lesion, and Hydergin apparently produced a beneficial effect on an acid lesion. The opposite response was seen when the lesions were reversed for each drug. Equivocal responses were had with both drugs, and also no response at all. In this way, by means of parenteral administration, these drugs could be of diagnostic value to determine the character of the symptom. If during the treatment of an alkaline lesion there was no recurrence of the symptom, an injection of dihydroergotamine as a test dose would indicate to me whether I should continue with the alkaline lipid therapy or vice versa. Hydergin was used in a similar manner.

Many papers have been contributed to the literature attesting the effectiveness of these substances in the control of headache and vertigo, and the reader is referred to the current literature. My observations about the clinical effect of the hydrogenated alkaloids of ergot were made on patients being treated with lipid therapy. These preparations were primarily utilized as a screening device because of their apparent opposite effects. In a comparison of the effects of the ergot derivatives with the effects of the relatively simple substances proposed by Revici, the conclusion is that the effects on the symptom are mediated through the effect on the pH of the abnormal metabolic focus. This phase of the problem has been discussed earlier.

A review of the recent literature on the beneficial results obtained by dihydroergotamine and Hydergin is interesting. Combes and associates [20] report 40 cases of herpes zoster treated with dihydroergotamine, of which 75%, or 30 cases, showed excellent to satisfactory results. Ten cases, or 25%, were failures. From my own observations, lipids with alkaline polar groups would also be effective. The group of 10 failures were cases of long standing. Here it appears probable that much scar tissue had developed and the treatment was ineffective for that reason, or the lesion had changed and lipids with acid polar groups might have been tried. Herpes is an acute inflammatory lesion, and in the early stages lipids with alcoholic radicals are indicated.

Horton and his associates [21] report 75% of 79 patients with typical migraine treated with dihydroergotamine. Of a group of atypical migraine cases consisting of 41 cases, only 36% attained relief. One can speculate, in the light of Revici's findings, whether the failures did not have an acid pattern, and might have been subjected to lipoacid therapy. Anderson and Rubin [22] report marked or complete remission of vertigo in 33 of 37 patients who were treated with Hydergin. Here the question is were all these cases those of vasoconstriction and subject to the vasodilating action of Hydergin, or was the beneficial effect due to the effect of Hydergin because of its effect on the acid character of

the lesion, as indicated by a change in the local pH? This sample must be considered to be a most unusual one. In any random sample, it would be rare indeed for so large a percentage of cases to appear that would respond to vasodilators or constrictors. In my own series of cases of vertigo and headache, the groupings always showed a distribution between the two patterns, alkaline or acid. Grenfell [28] treated 24 cases of tension headaches with dihydroergotamine, of which 21 were with good result and 3 cases showed no result. This group is also unusual compared with my series, in which samples as small as 12 cases, i. e., the migraine group, showed dualistic patterns; 8 were acid in character and 4 were alkaline.

The current literature would indicate that the failures with the use of ergot derivatives had indicated a real failure or only an apparent failure, due to lack of recognition of the dualistic pattern of the abnormal metabolism inherent in pathological lesions, and more than one substance would be necessary to control the pathological lesion, in this way controlling the symptom. Besides the known effect of these drugs, the additional effect on the pH at the lesion site is to be considered. It is to be inferred from these clinical observations that the pH at the site of the lesion is influenced by the administration of these substances and, in this manner, influences the metabolic imbalance of the lesion and influences the symptom. The visible manifestations are secondary to the fundamental one of pathogenesis. Further study on animals in the laboratory is necessary to determine the answer to this question. Should this action, which from a theoretical viewpoint appears probable, be confirmed, it would be further confirmation of the hypothesis of dualism as presented in this paper. From this point of view, the action of the drug would be nonspecific but the known pharmacologic effect would be the specific one.

From the above considerations of observations made clinically on patients subjected to the action of these drugs, it must be concluded that two effects should be considered. The known pharmacological actions, while considered a specific effect on the central nervous system, are accepted, and, in addition, a more specific effect at the abnormal metabolic level of the cell must be considered.

The interpretation of the effect was based on the patient's subjective response. The majority of the patients in this report had had previous treatment, without any benefit. This enabled them to be fairly competent in determining whether or not the result was acceptable to them. The fact that the painful symptom intensity could be increased by opposite-acting substances was additional confirmation.

From the analysis of the results of 120 cases taken at complete random, with painful symptoms, 11 cases were omitted because no response with either group of substances was obtained. These were placed in a separate group and were not included in the results. The reasons for omitting these 11 cases were discussed earlier. I wish to emphasize again that no response was obtained with either group of substances. Although they were treated with both groups of substances, to be certain that no response was present, as was determined by the continuation of their symptoms, I realized that there was no active lesion present and the probability of a response was very low. It would not be fair to the method to include them as failures. The lack of an observable response to the opposing groups of substances made these patients unacceptable to the method of treatment described (Table 4). Ninety-nine cases showed a definite response to one or the other group of substances. Twenty of these cases had a headache associated with vertigo, and were reported in a previous communication, all having had satisfactory results. These are in a separate group but probably should be classified with the neuralgias, and have been added to the present group because the headache was associated with vertigo. Of the remaining 89 cases, 15 cases showed an unsatisfactory result although an initial response was had. Continued treatment with

one or the other group of substances produced no satisfactory response. Seventy-four cases responded with an acceptable result. This was judged by the patient's response to the continued use of the same substances.

The analysis of the results by groups showed 84% satisfactory results for the vascular group, which consisted of a total of 49 cases. Undoubtedly in this group there were cases that could be classified as migraine by other observers, but for the purposes of this discussion, I do not consider this important. The small group of 12 cases classified as migraine, with and without scotomata, showed satisfactory results in all cases. Further confirmation of this result should prove informative in clarifying the underlying physiopathological process of this condition.

The neuralgias consisting of a group of 28 cases showed an over-all satisfactory result in 75% of the cases. This consisted of a small group of 9 males, with 7, or 69%, showing satisfactory results and a group of 19 females, with 14, or 73%, showing satisfactory results. I do not consider this group to be satisfactory because of the varied types of neuralgia within so small a group. This is not sufficiently informative for any one type, i. e., trigeminal neuralgia. The results would serve to show that a separate investigation of neuralgias could be profitably undertaken.

In the analysis of the results, two factors must be considered, and the above investigation confirms this. One factor, the application of the method, i. e., the tests that were used, the interpretation of the results, etc., is subject to changes, depending on the progress of the research. Depending on the means to exactly recognize the character of the symptom, the results of the practical application are expected to be greatly improved. This factor did not vary in this investigation.

The second factor, the substances utilized in order to modify the biology of the lesion, presents the same importance as the first one. I have added to the substances originally used substances evolved from the biochemical research. In the last portion of the cases, the improvement realized by this addition was rapid. Insufficient responses obtained with the original medications were accelerated or improved by the addition of new substances. Aside from the psychogenic factor of anxiety or causalgia that operates with any painful state, another factor might operate to mitigate the effect of the opposing substances utilized in this investigation. This can be sought in the anatomical course of the fifth nerve from its origin in the brain stem enclosed in the prolongation of the pia arachnoid mesh and dural envelope to the dural enclosure of the Gasserian ganglion at the superior surface of the petrous apex. Two factors can operate here. One is a pathological focus, such as a chronic pia arachnoiditis, expressed as a metabolic imbalance without structural change, and the compression exerted by the dural envelope at the site of this pathological focus in the nerve itself. Recent operative procedures decompressing the fifth nerve root and ganglion by simple incision of the dura without differential section of the fifth nerve root have produced relief. In cases that had been reoperated on after section had not produced relief, a successful result was produced with decompression of the fura over the area of ganglion and nerve.§ Although I have made the observation of beneficial effects of these substances and the effect could be sustained, the group is too small to be informative. In the light of these recent operative observations, the factor of local compression of a pathological focus might be considered to be a factor in explaining the failures in the neuralgic group of cases. Because of their course through various foramina, the branches of the fifth nerve and other cranial nerves are also subject to this compressive force in the presence of pathological foci. The good results obtained by various operators by decompression alone can be related to the biochemical effect also of the operative wound and the immediate metabolic imbalance induced by the operative trauma on the spontaneously occurring meta-

§ References 26 and 27.

bolic imbalance in the nerve lesion itself. According to Revici's theory, the products elaborated by this metabolic imbalance induced by operative trauma could have a beneficial effect on the neuralgic process.

The psychogenic factor has been stressed in the writings of many authors. This was obvious in this series of cases and was expressed as anger, anxiety, or fear. If the basic personality of the patient was of hypochondriac or depressive character, this was not affected by the medication after the symptom was alleviated. I was concerned in evaluating the effect of lipid therapy on the symptom of pain regardless of the psychogenic factors involved, and was surprised to obtain a favorable result in cases that had been classified as psychogenic in origin. The group of 11 cases which showed no response at all to both groups of substances showed a marked psychogenic overlay that seemed predominant in the mechanism of their symptoms. No previous treatment or other subsequent treatment was of any benefit to them. Most of the 11 cases were checked from time to time during the past five years, and continued to have their headaches. One important asset of Revici's method is the fact that by the existence of an opposite response to the two groups of substances utilized, without the knowledge of the patient, a real pathological component practically is separated from the psychogenic factor that can exist concurrently in the same patient. That the increase or decrease of the symptom is obtained with two or more different substances of the same group enhances the importance of this method for the exercise of judgment of this factor.

The methods pursued in this investigation were essentially the same as that utilized in the investigation of the symptom of vertigo. The control of the symptom was usually apparent after a short period of treatment with the proper group of substances. In addition, the nonsaponifiable fraction of butter and the sulfonized conjugated fatty acids from cod liver oil were utilized as additional alcoholic and acid lipids. I believe that the results were attained more rapidly. The period of observation varied from several days to several years, as will be noted in the tabulation of the 89 cases that were investigated. Many of these patients have been further contacted by letter or telephone. I believe that this study shows a correlation between the method of treatment and the favorable results obtained. In this instance, in headache as with the symptom of vertigo, periods of spontaneous remission occur, but the responses are so rapid and an unfavorable opposite response can be elicited with the opposite group of substances that this factor as a probable error can be eliminated. There were no deleterious effects from the use of these substances. Some patients have been taking them for a period of several years, whenever necessary, for recurrences.

Occasionally a case was seen in which the symptom of headache was in conjunction with another symptom. Headache and asthma, vascular headache and active peripheral vestibular chochlear disease, supraorbital neuralgia associated with recurring attacks of tension headaches, etc., were seen together in the same patient. When both symptoms reacted favorably to the same group of substances, there was no problem. However, when one symptom reacted favorably to a group of substances and the other was made worse by the same group of substances, the patient usually chose to be treated with lipid therapy for the symptom that was the most unbearable. The other symptom was treated by the usual means acceptable for that condition. In the above instances, I treated the headache in the first case, the peripheral vestibular cochlear disease in the second, and the supraorbital neuritis in the third case. The other associated symptoms were treated by the usual means utilized for those symptoms.

Occasionally a symptom can change character, i. e., from alkaline to acid, or the opposite may occur during treatment. A change in the group of substances utilized has the same beneficial effect.

As a therapeutic aim in a condition in which many etiologic factors are involved, the application of Revici's hypothesis was successful in obtaining a result in a large percentage of cases presented in this communication. The different etiologic and pathogenic factors can thus have the same physiopathologic metabolic pattern. A specific approach to this problem has been impossible and, for this reason, prompted this investigation. The nonspecific effect of other drugs has been indicated.

The material presented in this and my two earlier communications concerned with the investigation of Revici's hypothesis points the way for an intelligible field for investigation of pathological conditions found in the field of otolaryngology, and should prove of great practical importance.

SUMMARY AND CONCLUSIONS

A series of 120 patients having the symptom of pain in the region of the head and neck has been studied.

The symptom of pain has been analyzed according to Revici's concept concerning the alkaline or acid pattern of the painful symptom.

Eleven cases were eliminated because no pattern was identified; 109 cases showed an acid or alkaline pattern. The results showed a satisfactory result in 84% of the vascular headaches, 100% in migraine headaches, and 75% in the neuralgic group. These results indicate a correlation of Revici's concepts and the results achieved. The simplicity of this method is indicated.

Additional data about Revici's views are given. The relationship to homeostasis and the biology of the cell is indicated.

The problem confronting the clinician in treating cases of this type, on account of the many factors involved, is simplified according to Revici's concept of dualism.

Two additional active products are presented, one acid and the other alcoholic. The data here presented concerned the incidence of the control of the acute symptoms while under observation. Further experience with this method will be necessary. As the method stands, it is a practical method of therapy for the control of pain. Recurrences were seen and controlled.

Nikethamide (Coramine) donated by the Ciba Pharmaceutical Products, Inc. Dihydroergotamine (D. H. E. 45) and Hydergin donated by the Sandoz Chemical Works, Inc. The injectable lipid substances used in this investigation were furnished by The Institute of Applied Biology.

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The Facial-Wound Problem

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The effect of wounds on the face is so depressing from functional, economic, and social standpoints that an acceptable restoration of the facial mask has always been regarded by surgeons with deep concern.[1] Facial wounds present problems not encountered elsewhere in the body because of their exposed position and the importance of the contained structures.

A minor infraction of technique in their repair is likely to incur serious consequences. For instance, a malalinement of a lid margin may cause displacement of the cilia, ectropion, or coloboma, with consequent ocular damage. Faulty suturing along the mucocutaneous junction of the lip may give rise to noticeable deformity. If continuity can be restored only by the addition of new material, difficulty arises in securing tissue that will match the surroundings in color and texture.

The mucous membrane lining the orbital, buccal, and nasal cavities requires careful attention. Faulty suturing of the conjunctiva may result in symblepharon, and of the buccal mucosa in interference with mastication, phonation, or the fitting of a denture.

The bones of the face present a special problem. Because of their fragility, they are easily broken; and since they are practically subcutaneous, a faulty reduction or the loss of a fragment may create not only marked disfigurement but also impairment of function. For example, a fracture of the malarzygomatic compound may lead to flattening of the face, distortion of the lateral canthus and/or diplopia. A faulty reduction of a displaced nasal bone is likely to interfere with respiration and sinus drainage,[2] and a malalinement of the maxillae causes interference with mastication.

GENERAL CONSIDERATIONS

Successful management of facial wounds demands a review of the following:

I. A General Assessment of the Injury

Are there conditions present whose treatment takes priority over that of the facial wound—e. g., respiratory obstruction, hemorrhage, or shock? Is there other damage, such as cerebral or abdominal, that requires the immediate attention of a neurosurgeon or general surgeon? Is the wound of such a character that consultation should be sought? The face embraces a field shared by the otolaryngologist, ophthalmologist, and dental surgeon, and frequently the combined efforts of all will be necessary to meet the challenge. Is there bone damage or the presence of imbedded foreign bodies demanding radiographic examination? (Gottlieb * advises that all wounds be investigated tangentially with low voltage and with the new type of flexible intensifying screen. This will frequently show up glass fragments, wood splinters, and bits of clothing not detectable by other means. A small film in the mouth may demonstrate the presence of a foreign body in the cheek.)

How much of the wound area is due to actual loss and how much to displacement and retraction of the margins? The answer to this question will determine whether or not new tissue will be required for closure. The actual destruction can be estimated by inspection and exploration of the wound. The problem is to determine the amount of damage in terms of skin, mucous membrane, supporting tissues, blood vessels, nerves, and glandular structures. In ascertaining the

* Personal communication to the authors.

simulated loss, consideration must be given to the location of the wound, its relation to tension lines, and the amount of edema and inflammation.

II. History

A. How was the wound sustained? *B.* Where did it take place? *C.* How much time has elapsed since its infliction? The answers to these questions will largely determine the method of surgical cleansing and closure.

A. How Was the Wound Sustained?—Wounds result from a forcible displacement of tissue beyond the limits of their elastic recoil. Their character will depend upon (1) the amount of potential energy liberated by the traumatizing agent, (2) the rate of its expenditure, (3) the area of application, and (4) the character of the missile.

1. Potential Energy Liberated: In the destruction of tissue the velocity of the traumatizing factor is more important than its weight. For instance, an agent of definite weight, propelled at a definite speed, carries a definite amount of energy. When the weight is doubled, the energy is likewise doubled. But if the velocity is doubled, the energy is quadrupled.† In the case of a low-velocity weapon, like a knife, only the tissues with which it comes in contact are damaged. By contrast, a high-velocity missile, such as a flying piece of glass, metal, or wood—so frequently encountered in automobile accidents or in gunshot wounds—not only cuts the tissues but imparts kinetic energy to them and flings them away from the path in a radial direction, converting them into secondary missiles. Momentarily a cavity many times the size of the traumatizing agent is formed ‡ (Fig. 1). Upon subsiding the negative pressure in the cavity pulls contiguous foreign bodies into the wound. The resultant damage comprises not only local destruction of tissue from stretching and tearing but also disintegration of a large volume of more distant structures.[8]

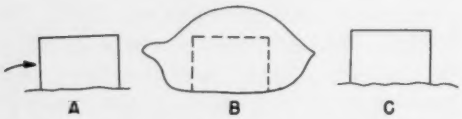

Fig. 1.—Effect of high-velocity missile on gelatin block. *A*, original profile of block; *B*, profile during maximal distortion; *C*, postdistortional profile. For details, see Black, A. N.; Burns, B. D., and Zuckerman, S.: Brit. M. J., British Medical Association.

2. Rate of Expenditure: Any factor which increases the time over which the energy is discharged will decrease its destructive effect. For instance, on a face which is free to move, the impact of the blow is prolonged and may cause little damage (a pugilist "rocks" with the punch); but a similar blow delivered while the head is fixed may produce marked injury.

3. Area of Application: The smaller the area over which a fixed amount of energy is discharged, the greater the damage. Thus, a blow struck with the edge of a plank will cause more damage than one delivered with the flat side, though the amount of energy expended is the same in both instances. Similarly, a fall against a projecting object, such as a knob on the dashboard, will prove more serious than one against a flat surface. If the energy is discharged over a large area, there may be no external wound, and yet considerable damage to the deeper tissues may ensue, the result depending on the manner in which the energy is propagated and the difference in elasticity of the tissues. The force may be focussed on some point at a mechanical disadvantage. For instance, a blow on the body of the mandible may fracture the condyle. All tissues permit a given amount of stretch before tearing. The greater the elasticity, the less the damage when they are subjected to violence. The vessels, subcutaneous fat, and bones have less stretch than the overlying skin and are often damaged without significant skin injury (Fig. 2).

4. Character of the Missile: A jagged, irregular missile will cause more destruction than a smoothly contoured object. The cohesiveness of the agent also plays a part.

† References 3 and 4.

‡ References 5 and 6.

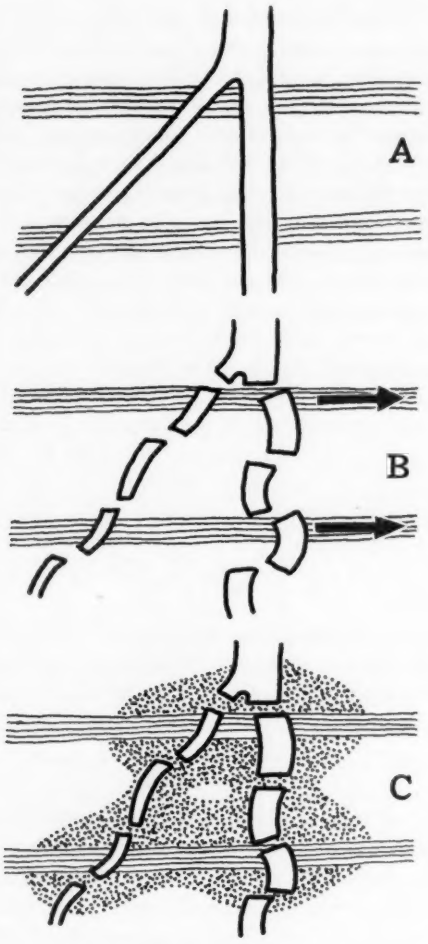

Fig. 2.—Rupture of blood vessels, owing to difference in elasticity. *A*, normal position of blood vessels; *B*, rupture of vessel, due to its lesser elasticity; *C*, hematoma at site of rupture. (Policard, *A.*: Evolution of War Wounds, Masson & Cie.)

For instance, a piece of steel is less damaging than glass, which is likely to fragment and fan out to destroy distant tissue. If the traumatizing agent is of a plastic nature, the damage will be less, because some energy will have been expended in deforming the agent itself. Furthermore, the change in shape on contact increases the collision area and prolongs the period during which the energy is discharged. For example, a rubber club is less damaging than one made of wood.

B. Where Did the Wound Take Place?—A cut sustained in a clean kitchen with a knife, chopper, broken glass, or tin edge is clearly defined and requires less surgical cleansing than a wound received in an automobile accident, with crushing of tissue and ground-in oil, dirt, bits of metal, or wood.

C. How Much Time Has Elapsed Since the Infliction of the Wound?—In wounds seen within approximately four days the absence of fibrosis obviates the need of paring the margins, with a resultant sacrifice of tissue. The skin is still elastic and permits undermining. Furthermore, the flexibility allows the individual layers to be sutured in staggered planes, which assures a stronger union, disperses the pull of the scar, and thereby lessens the secondary distortion. In injuries seen later the walls of the wound have become so rigid that they require some freshening, and layer-to-layer coaptation is no longer feasible. Closure must then be obtained by a suture incorporating all the layers. While this has the advantage of burying less foreign material, it has the great disadvantage not only of causing subsequent distortion, due to the pull of a continuous scar, but also of being likely to leave dead spaces, owing to the rigidity of the walls.

III. How Soon Can the Wound be Closed?

Can the closing of the wound be accomplished at once, or must the wound be left open for closure at a more favorable time? Here it is worth while to define the following terms:

Primary closure indicates closure immediately after injury; delayed primary closure, some time after injury but before fibrotic changes have taken place (about the fourth day); secondary closure, after fibrotic changes have taken place. Obviously then, primary and delayed primary closures do not require freshening of the wound edges. Secondary closure, however, demands paring of the margins.

The sooner continuity is restored, the more satisfactory the result, for this eliminates edema and serum collection, assures

rapid healing, reduces the cost of hospitalization, and prevents fibrosis, with its consequent impairment of function and pronounced deformity. To give an example, in an accidental avulsion of the skin of the nose, the separation takes place above the periosteum, which if left to itself will degenerate, leading to necrosis of the cortical plate. It will require weeks for sufficient granulations to form to permit skin grafting. On the other hand, if it had been closed by the immediate application of a split-skin graft, healing would have been complete at the end of a week or 10 days. Loose tags and scraps of tissue, vital to repair, are still soft and pliable and can be reassembled and tacked down in their normal relationships. If closure is delayed, these tags may become so distorted that they have to be sacrificed.

While all agree that immediate closure offers the best results, certain conditions must be present to justify it: (1) The wound must be clean or be capable of being made so, (2) the margins must be well defined, and (3) the wound itself must remain under observation for a week to 10 days, so that it may be laid open at once should any evidence of interference with healing supervene.

In the absence of the above prerequisites—for instance, (1) in wounds in the vicinity of large blood vessels and nerves—one may be confronted with the choice between complete débridement, with the certainty of a crippling deformity, and incomplete débridement, with the risk of trapping proteolytic products (pus), which by their digestive action would cause disruption, with greater damage than if the wound had been left open. (2) When the tissues are necessary to an acceptable restoration but are of questionable viability, a delay in closure to allow a line of demarcation to form is preferable to the sacrifice of material that might have lived. (3) When the swelling is extensive and the cut edges are so distorted from hemorrhagic infiltration, edema, or inflammation that their normal realinement is impossible, it is better to wait two or three days for the inflammation to subside.

Under the above circumstances delayed primary closure is employed. While it subjects the patient to two operations, its safety outweighs all other considerations. Closure is visualized as one operation performed in two stages[9]: (*a*) The first stage is a preliminary surgical cleansing, followed by an interval of four days, to determine its success. (Before the fourth day the line of demarcation between the living and dead tissue is not clearly established.) (*b*) In the second stage the wound is exposed and investigated, its character being determined by the gross appearance, rather than by the bacterial content.[10] If the wound looks clean —i. e., if the surrounding tissues are not indurated or tender, if there is minimal or moderate discharge and little inflammatory reaction—it is closed, even though it may prove on culture to harbor pathogenic bacteria.

In wounds in the granulating stage, the granulations and fibrotic tissue are removed, and closure is obtained either by approximation or by resurfacing (secondary closure).

MANAGEMENT

We treat wounds in accordance with their biologic evolution and divide the stages into the following: (1) The stage of traumatic inflammation (quiescent, or lag, period). Here the biologic changes are concerned with local and general defense responses for the conservation of life and take priority over those of healing. (2) The stage of suppuration. Physiologically, this is the stage of demolition. Before the construction of a building, the rubble must first be removed. Just so in a wound, before healing can take place, foreign bodies and dead tissue must be demolished. (3) The stage of granulation, proliferation, contraction, and epidermization. Physiologically, this is the stage of repair.

While there exists no sharp line of cleavage between these stages, and the treatment must necessarily be modified at points where they overlap, nevertheless, for us this classification sheds light on the proper treatment.

STAGE OF TRAUMATIC INFLAMMATION

The stage of traumatic inflammation represents the period from the receipt of the wound to the development of suppuration and/or granulation. It lasts from one to three days, depending upon the amount of damaged tissue, the quantity of foreign matter present, and the integrity of the blood flow to the part. In a sense it corresponds to Carrel and Du Noüy's §quiescent, or lag, period in the growth of cultures of microorganisms.

Biologic Changes.—The biologic changes which take place are the following:

1. Provisional Wound Closure: This is an adaptive mechanism on the part of the body to minimize the loss of fluids and prevent the entrance of foreign substances. The plasma escapes from the blood stream into the wound, where it coagulates in a protective coating. The blood clots in the vessels to stop the hemorrhage. The lymphatics become clogged and mechanically shut off the rest of the body against the ingress of foreign matter.

2. Defense Against Organisms and Chemicals: Locally, the blood vessels dilate, to bring increased nutrition to the part. The pores between the endothelial cells enlarge, to facilitate the extravasation of plasma and leucocytes. The leucocytes exert their defensive phagocytic activity, and the plasma dilutes any poison present in the wound and on coagulating further isolates the damaged area. Clinically, these changes are manifested by redness, swelling, and edema of the margins of the wound.

The general reaction to trauma corresponds to the homeostasis of Cannon || and the adaptive reaction, as postulated by Selye.¶ The latter divides the syndrome into three stages: (*a*) The alarm reaction, in which adaptation to trauma is gradually acquired. It is manifested by endocrine and nervous phenomena. Certain factors (stressor factors) stimulate the anterior lobe of the pituitary to produce excessive amounts of adrenocortical hormone (ACTH). The ACTH then stimulates the adrenal cortex to produce excessive amounts of the hormone cortisone, which creates profound disturbances in the metabolism of proteins, carbohydrates, water, and minerals and alterations in the blood levels of glucose, vitamin C, and calcium. The cellular elements in the blood show a sudden decrease in the number of lymphocytes and eosinophiles. (*b*) Stage of resistance, in which adaptation is fully developed, and (*c*) stage of exhaustion, in which adaptation is lost. How these changes help the body to withstand trauma is not clear. Clinical reports are not in agreement, and much theorizing exists. Nevertheless, it is possible to piece together from the tangled skein the semblance of a biologic pattern. The concept is intriguing, for its suggests active means to aid the natural nonspecific adaptive mechanisms to trauma, whereas current treatment is limited merely to an attack on the pathogens, measures to expedite healing by the application of various physical and chemical agents to the wound, and the giving of vague advice as to rest, diet, elimination, etc.

Clinical Considerations.—This stage is easily recognized by the absence of signs of healing, the retraction of the tissue planes (reentrant angles),[19] the presence within the wound of damaged tissue, and the absence of tensile strength, suppuration, or granulations. Evidences of inflammation will vary from a slight redness and swelling to marked edema and cellulitis.

Treatment. — Generally speaking, no wound on the face should be permitted to heal spontaneously, for such healing is likely to exact a high penalty in crippling deformity, impaired physiology, many painful dressings, and economic waste.

The objective in this stage (traumatic inflammation) is to prevent the wound from passing into the next stage—that of suppuration and/or granulation—and this demands (1) removal of dead tissue and foreign bodies, (2) restoration of continuity, and (3) observation for 7 to 10 days.

§ References 11 and 12.

|| References 13 to 15.

¶ References 16 to 18.

1. Removal of Dead Tissue: Adequate surgical cleansing contributes more to the healing of a wound than any other single factor. In wounds with little damage the natural processes can be depended upon for the elimination of the dead material. But in wounds with extensive destruction the body may not be able to meet the demand, so that deliberate surgical removal becomes mandatory.

The counsel of perfection is to remove all dead tissue, thus converting a lacerated and contused wound into one which is surgically clean and fresh [20] (Fig. 3). On the face, however, this principle often demands a compromise. Complete débridement, as carried out in other parts of the body, is not practical here. The sacrifice of even a small bit of questionable facial tissue that might have survived may result in great distortion and impairment of function.

Fig. 3.—Wound excision. Friedrich's original diagram, showing removal of infected tissue, as if it were a malignant ulcer; *a*, infected tissue; *b*, dotted line indicating extent of excision. (Friedrich, P. L.: Zentralbl. Chir., Barth.)

Tissue obviously dead, as well as accessible foreign bodies, presents no problem. These must be removed at the earliest possible moment, for they form a mechanical barrier to healing. Moreover, the dead tissue will undergo decomposition into pus. Ferments in this pus destroy contiguous parts, thus forming more pus, so that a vicious cycle is established. Obviously, a dependable substitute for surgical cleansing—i. e., a method which would remove the nonviable tissue without injury to the living—would be a boon to wound management. Attempts have been made to accomplish this with the aid of chemical agents (Dakin's solution and pyruvic acid). In 1948 Tillett and his associates [21] employed bacterial enzymes (streptokinase, streptodornase, etc.). But these on the face are of little practical value, although they offer fascinating possibilities.

The real problem lies in what to do with damaged tissue which may or may not survive. It is clear that if all questionable tissue is cut away, there would necessarily be a sacrifice of some material that might have lived; and, conversely, if not enough is removed, there is the danger of trapping proteolytic products, with its dire consequences. Bowers [22] asks:

> Can we develop a quick test for nonviability? Can a fluorescent and an ultraviolet test be made accurate and practical? Can an intravital dye be developed for this purpose, depending on color rather than on fluorescence?

Unfortunately, there are no means except clinical criteria to determine the viability of tissue. Reliance must be placed on observation of oozing from cut edges, color and circulatory return following pressure, and dimensions of the attached tags in relation to the blood supply.

The wound is irrigated with warm saline solution (110 F), a chip syringe and suction being employed. This removes loose foreign bodies, débris, and blood clots. Superficially imbedded particles likely to produce tattoo marks are extracted with a dental elevator, under a magnifying glass. If deeply situated, they are excised with a knife. If the débris is irremovable, the soiled area is resected.

The edges of the wound are separated with dural hooks, so that the depth can be visualized. For more adequate exposure, the wound may require enlargement by incisions along the natural tension lines. This procedure is less traumatizing than forcible retraction. Hematomata between tissue planes constitute foreign bodies and are evacuated. If left in place, they lead to formation of scar tissue, which upon contraction distorts the normal contour.

Since the zone of devitalization is most extensive at its deepest part, débridement is conducted from within outward. Soiled bone is cleansed with a chisel, starting at the clean end and working toward the soiled area. Displaced or rotated fragments are realined. If loose, they are cleansed and replaced as grafts. Muscle which is black, dark red, pale, or deep purple and does not bleed or twitch when pinched is trimmed until red coloring and free bleeding appear. Care is taken not to damage the nerve supply. Amputated parts, if they possess a broad base, are cleansed and sutured back in place, with good prospects of success. In the case of the ears the attachment is too narrow for the reestablishment of the circulation. Therefore the soft tissue is removed, and the cartilage is imbedded in the skin of the mastoid region for future use.

Subcutaneous fat which has lost its lobulated structure or is partly liquefied and does not bleed is trimmed. Soiled blood vessels and nerves of significant size are merely washed. Any dead tissue immediately surrounding them is removed. Special care is taken around nerves. If a blood vessel is cut, the collateral circulation usually reestablishes the nutrition of the part, but in nerves there is no such collateral supply.

During the cleansing large bleeding vessels are ligated. The control of hemorrhage from small vessels calls for a decision between the use of multiple ligatures, with the introduction of much foreign material, and the chance of spontaneous hemostasis.

In regard to foreign bodies, common sense is used. If accessible, they are removed. But if they are deeply seated and their extraction would entail considerable dissection, they are left in place. Should they cause trouble later, they are dealt with as an elective procedure. Generally speaking, if the object is insoluble, smooth, nonporous, and chemically or electrically inert, it will create no disturbance. But if it is porous, partly soluble, and chemically irritative, such as a splinter of wood or a piece of clothing, it will probably require removal.

The skin of the face is of all tissue the most irreplaceable but, fortunately, because of the good blood supply, also the most viable. It is seldom necessary to excise more than 3 mm. (⅛ in.) of the wound margins. Skin that is red, reddish-purple, or blue is retained. Black and greyish-black skin is excised until bleeding is reached. Flaps with pedicles so slender as to make them surely nonviable are removed, the subcutaneous tissue is excised, and the overlying skin returned as a full-thickness graft. At the completion of the operation the wound should appear as a smooth, dry cavity lined with viable material, no pockets being left for the collection of discharges.

2. Restoration of Continuity: The closure of a wound is second in importance only to its surgical cleansing.

A. Closure without addition of new tissue. If sufficient tissue is present, the margins

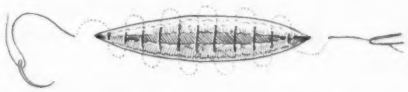

Fig. 4.—Removable tantalum suture, to hold deep structures in apposition.

are approximated. The technique has been described elsewhere.# Briefly, approximation, like surgical cleansing, should begin from within. The deep structures are united first, to provide a support for the skin and to avoid the subsequent spreading of the surface scar and the formation of areas of depression. We find the figure eight or a deep tantalum removable suture to be most satisfactory (Fig. 4). Irrespective of the method employed of bringing the deep structures into juxtaposition, the skin margins must fall into easy apposition. The temptation to suture under tension is a fatal error and must be resisted. It causes strangulation of the blood supply, followed by sloughing and the production of a defect larger than if the wound closure had not been carried out. Undermining for the relief of tension exacts a penalty; it draws the neighboring tissues

References 23 and 24.

out of position and militates against the production of a good scar. If the undermining is extensive, there is the additional danger of sloughing.

When abundant skin is present for closure, the frayed and pulpified edges are cut perpendicular to the surface, to create smooth, even margins for approximation and thus insure a better scar. Otherwise, each ragged projection is made to fit into a corresponding notch, provided the base of the flap is of sufficient size. It is easier to remove the residual scar than to replace lost tissue.

The skin is united with the finest sutures on eyeless needles. Entrance and exit points are placed 2 mm. from the wound edges, and an ample bite of the deeper layers is taken. Sutures at a distance from the skin margins are likely to produce cross-bar scars, resulting in greater disfigurement than if the wound had been left unsutured. All knots are tied loosely; otherwise, the postoperative edema will cause them to cut through. A drain is not employed, since it tends to make the contiguous edges roll in.

If the wound crosses tension lines, a "fiddle-string" distortion is likely to ensue. Therefore, the skin is united in the form of small interlocking flaps. At mucocutaneous junctions the points to be united are marked out before the anesthetic is given. In the eyebrow the hair is clipped but not shaved. Wounds limited to the mucous membrane are treated in the same manner as skin wounds and painted with pigmentum iodoformi compositum (Whitehead's varnish).

In wounds involving the full thickness of the part, such as the buccal area, suturing is carried out in layers, the mucous membrane being coapted on the mucosal side. McMillen's on-end mattress suture serves the purpose best. It is easily applied and automatically everts the cut edges. If the parotid duct is severed, the surface wound is closed and a drain inserted into the mouth and sutured in place. In lacerations incorporating all the layers of the lid, allowance must be made for cicatricial contraction, with its consequent notching, and this is prevented by uniting in Wheeler's [25] "halving union." A single mattress suture of 00000 silk is used, passed through skin, subcutaneous tissue, muscle, and tarsal plate but not through conjunctiva. Full-thickness ear lacerations are closed on both the anterior and posterior surfaces, the sutures being passed through skin but not cartilage. Cut facial nerve branches are usually too fine to be sutured. But fortunately the resultant paralysis disappears spontaneously.

Dressing. The dressing is made small enough to permit inspection of the surrounding parts. The removal of sutures begins on the fourth day, on which one half are cut but not withdrawn. On the fifth day the cut sutures are removed and the balance cut. On the sixth day all are withdrawn.

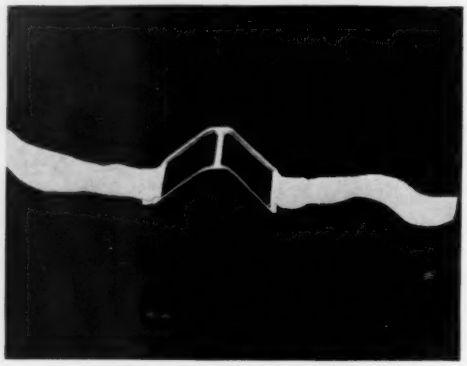

Fig. 5.—Wire bow applied to wound with adhesive, to prevent spreading of scar.

Since the wound requires about two weeks to regain its normal tensile strength, it is supported during that period with a wire bow (Fig. 5). After two weeks advice is given to massage the part with a bland ointment. Any tendency toward hypertrophy of the scar is checked by x-ray or radium therapy. Three to six months later the scar is revised if necessary.

B. Closure with addition of new tissue. If there is not enough tissue for closure, new material must be added in the form of a graft or flap. While a graft is useful to expedite healing and to replace skin losses of the eyelids and hair-bearing areas, it finds little applicability elsewhere on the face. The thicker the graft, the better will be the tex-

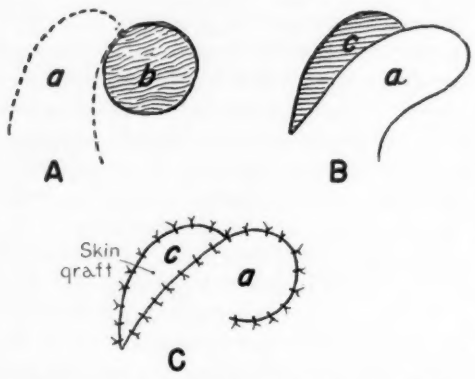

Fig. 6.—Basic principle underlying swinging-advancement flap. *A*, flap outlined: *a*, dotted line shows flap to be raised; *b*, defect. *B*, flap rotated into defect: *a*, flap; *c*, secondary raw area. *C*, flap sutured in place and raw area skin-grafted: *a*, flap; *c*, skin graft.

ture. Therefore, on the face only full-thickness skin grafts can be employed. But such grafts are subject to a partial loss amounting to 25%. The skin nearest the area to be covered offers the best match. As a rule, the secondary defect thus created does not justify the exchange. In addition, it is impossible to anticipate the amount of contraction or to foretell the change in color.

As for flaps, while they can fill a defect involving more than a skin loss, and undergo less contraction and discoloration than does a graft, on the face they leave much to be desired, owing to the "lumped" appearance arising from the cicatrization of the base and the obstruction to the lymphatic and venous drainage. Despite their objectionable features, however, forehead flaps are used to repair nasal defects and scalp flaps to cover the bearded portions of the face and in cases in which the contiguous skin is not usable.

In our experience, the best restoration of continuity is obtained from a contiguous swinging-advancement flap, as outlined by the face-lift incision.[26] It has many advantages: It transfers the wound from the face to a less conspicuous site on the neck. The donor region in the neck may be closed by direct approximation or with a graft, which is more certain to take on the secondary than on the primary defect. With careful planning the residual scar can be hidden in a natural fold or in the hairline. This flap matches the lost substance in pigmentation and texture. It can easily be maneuvered into position, and adequate nutrition is assured by the external maxillary artery. The technique has been described elsewhere.[23] Figures 6 and 7 will serve to demonstrate the basic principle. Unfortunately, these diagrams do not give a true picture of the utility of the flaps, since so much depends on their mobility and elasticity.[23]

In losses involving the full thickness of the palpebral, buccal, or nasal region, in addition to cover and support, a lining must be supplied. Such repair is usually carried out at a later date. To assure prompt healing and minimal scarring and furnish a good foundation for the future repair, the skin edge is united to that of the mucous membrane. Our tendency is toward primary closure. The adjacent skin is rotated 180 degrees, epithelial side in and raw side out, to form a lining. A cover is supplied by a swinging-advancement flap. Space does not permit a discussion of the technique.

3. Observation: Closure in this stage requires observation for a week to 10 days. The

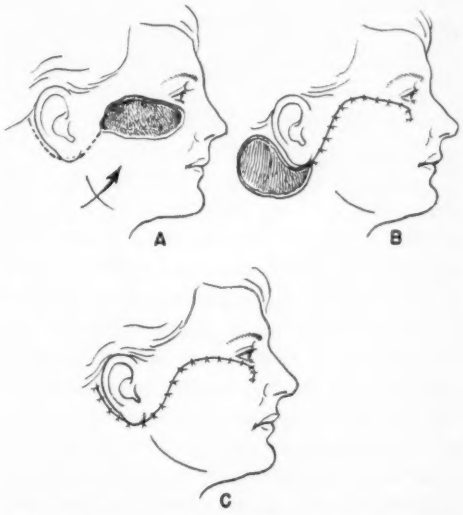

Fig. 7.—Closure of wound by swinging-advancement flap. *A*, dotted line indicates face-lift incision for mobilization of flap; *B*, flap rotated into defect; *C*, secondary defect closed by approximation.

part is inspected daily for signs of impaired circulation, undue bloodstaining of the dressing, or odor of sloughing. Persistent pain or any evidence of invasive phenomena, manifested by a rising pulse rate and temperature, increasing pain, edema out of proportion to the circumstances, and/or enlargement of the proximal lymph nodes, require immediate removal of the dressing for inspection.

Stage of Suppuration (Demolition Stage)

The stage of suppuration is characterized by the demolition of the dead material in the wound.

Biologic Changes.—Proteolytic ferments (comparable to pepsin and trypsin)—probably originating in the destroyed elements—disintegrated leucocytes, and bacteria digest the dead mass into small molecules capable of being picked up by the lymphatics and phagocytic cells. The denser the tissue, the longer the time required for digestion. For instance, fat, nerves, and muscle are dissolved early, while connective tissue, fascia, and bone liquefy late. If the body is unable to meet the demand, the débris and liquefied extravasated cells spill over as pus. If the dead material resists autolysis and is nonirritating, it is encapsulated; otherwise, it becomes separated by a line of demarcation and is expelled as a slough or sequestrum.

Clinical Considerations.—The wound is covered with a slough exuding a profuse purulent discharge. The edges are shelving, swollen, congested, and edematous.

Treatment.—Because of the difference of opinion as to what constitutes suppuration and infection, and because the treatment will depend upon one's concept of these terms, a definition becomes essential. Suppuration, as we see it, is a local digestive process for the purpose of freeing the wound of dead material. To define infection is not so easy. We classify infection as follows: (1) Progressive invasion, a spread of the destructive process by contiguity or continuity to the surrounding tissues, as manifested by cellulitis, lymphangitis, phlebitis, and adenitis. It may be compared to the spread of a forest fire. (2) General invasion, in which the destructive products and/or their causative agents travel via the blood stream—for example, the migration of an embolus from an upper-lip wound by way of the angular vein to the cavernous sinus—or tetanus, anthrax, gas gangrene, etc. These wounds are characterized by signs of toxic absorption predominating over the local phenomena.

The objective in the stage of demolition is to prevent the wound from passing into the next stage, that of granulation, proliferation, contraction, and epidermization.

The advocated treatment of a suppurative and/or infected wound in other parts of the body is not applicable on the face. To enlarge such a wound, open pus pockets and remove foreign bodies and obviously dead tissue, without disturbing the living walls of the wound, for fear of breaking down defensive barriers and opening up new channels for the spread of infection; to establish drainage by irrigation or compresses moistened with some mild antiseptic solution or by light packing with gauze strips leading to the surface and chemical agents applied to expedite healing would on the face result in distortion, impaired function, and disfiguring scars. With the aid of appropriate chemotherapy there need no longer be fear of breaking down defensive barriers or "fanning the fires of infection"* by surgical intervention.

The treatment consists of a preliminary surgical cleansing, followed by an interval to determine its success, and closure.[9]

Stage One: The wound is surgically cleansed, as described above, even though suppuration of devitalized tissue and/or infection of the margins may be established. It is then covered with fine-meshed gauze, and a compressive dressing is applied.

Interval: The dressing is left undisturbed for four days. Each day the patient's chart is examined, the circulation of the part checked, and the odor of the external dressing noted.

Stage Two: At the first change of dressing the entire wound is exposed and investigated. If it is clean—i. e., filled with a fresh blood

* Churchill, E. E., quoted by Babcock.[27] References 28 and 29.

clot, with no induration or tenderness, and with no evidence of surrounding inflammation or suppuration—the blood clot is removed and the wound closed (delayed primary suture). If, on the other hand, the wound is moderately soiled—i. e., if residual necrotic tissue is present, with a purulent exudate—a decision must be reached whether the wound can be cleansed and closed or be left open and closure undertaken only after it is certain that all dead tissue has been removed and invasive infection is no longer to be feared. If the wound is definitely soiled—i. e., if it is covered with a greyish exudate, the adjacent tissues are tender and indurated, and the skin margins red and edematous; and if tags of skin, fat, or muscle which at the initial cleansing seemed viable but have died in the interim are present—the surgical cleansing is repeated, all necrotic tissue is removed, and any remaining foreign bodies or blood clots are evacuated. The pressure dressing is reapplied and left in place for another four days. If after this time closure is still unfeasible, the above steps are repeated until a suitable surface for closure is obtained.

Closure with Addition of New Tissue: When the addition of new material is necessary to obtain closure, the treatment is carried out in the same manner as in the stage of traumatic inflammation, with the exception that in Stage Two an element of safety is added. In place of employing the contiguous advancement flap, the area is covered with a skin graft. And since the sole purpose is to expedite healing, and the graft is later to be replaced with a more suitable cover, it makes little difference whether the graft be autogenous, homogenous, or preserved.

Stage of Granulation, Proliferation, Contraction and Epidermization

In the third stage healing begins. It is characterized by the presence of granulation tissue, fibroblastic contraction, and epidermization.

Biologic Changes.—In case there is no appreciable loss of tissue, the wound margins are held together by fibrin and blood clots, which are later replaced by fibroblasts. Where there is a loss of tissue, however, continuity can be restored only by the formation of granulation tissue.

The granules, composed of solid buds sprouting from the capillaries, in time are hollowed out and become filled with blood [7] (Fig. 8). The wound is thus provided with a protective covering of capillaries. When the granulation mass attains the level of the neighboring skin, it furnishes a base for the epithelial cells, which migrate from the edges of the wound over the granulating surface.

Synchronous with the formation of granulation there is an infiltration of cells which

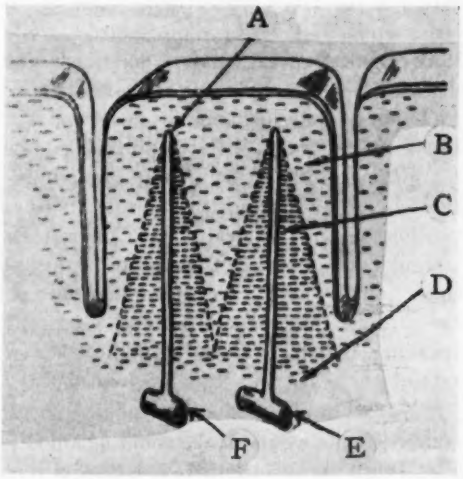

Fig. 8.—Diagrammatic longitudinal section of granulation tissue. *A*, blind end of capillary; *B*, zone of edema; *C*, zone of fibroplasia; *D*, connective-tissue base; *E*, arterial capillary; *F*, venous capillary. (Policard, A.: Evolution of War Wounds, Masson & Cie.)

split off collagenous fibers, with the production of scar tissue, which eventually fills the gap. These fibers are laid down in superimposed sheets, lying parallel to the floor of the wound and at right angles to the granulation-tissue layer. In old wounds the scar tissue may be so thick and dense as to interfere with the penetration of an adequate blood supply to the surface, thus bringing healing to a standstill. During this stage the wound decreases in size. About three-fourths of this shrinkage is accomplished by the

pulling-in of the surrounding tissues, and the balance of the wound is filled with scar tissue.

Generally speaking, cicatrization follows the laws of diminishing returns. Healing is usually rapid at first but with time becomes slower. According to Carrel,[12] the rate is in proportion to size. In a wound with a diameter of 60 to 70 mm. the normal reduction is 9 to 10 mm. in 24 hours. In the same period in a wound of 40 mm. the reduction is about 3 mm. In one of 20 mm. the rate is very slow and becomes about zero when the edges have reached the distance of 10 to 15 mm. apart.

Unlike cicatrization, which is directly proportional to the size of the wound, epidermization is inversely proportional. That is, in large wounds epidermization is tardy, while it occurs early in smaller wounds. If the distance between the edges is more than 12 to 15 mm., epidermization is slow, but if it is less than 10 mm., it is rapid. When the margins are 20 to 25 mm. apart, epidermization comes to a standstill. Closure here is possible only by surgical means. In wounds irregular in shape epithelization begins at those points where the edges of the old epithelium are nearest each other. Generally speaking, under ideal conditions the average rate of epithelial growth is 0.5 mm. daily.

General Considerations.—Under optimal conditions the wound looks about as follows: Flush with the surface there is a central zone of uncovered granulations which appear smooth, firm, salmon-pink, or red. Discharge is scanty, and the margins are congested, with little inflammation. Epidermization is seen as a thin bluish line spreading from the skin margins.

When the sequence of events in the reparative process is disturbed—for instance, by the presence of foreign bodies, of trauma such as that inflicted by frequent changes of dressing, profuse discharge, or excessive size of the wound—the phases of healing are thrown out of timing. Under these circumstances the wound is filled with soft, cyanotic, nodular, exuberant, grayish-yellow granulations which bleed easily and exude pus. In time healing may be brought to a standstill, the surface of the wound being smooth and glazed and the margins congested and indurated. On palpation a cord of fibrous tissue can be felt encircling the wound like a purse string. The skin edges are inverted and shelving and before union can take place must be freshened.

Treatment.—The objective is to prevent spontaneous healing. As granulation is the forerunner of cicatricial tissue, the greater the amount, the more extensive the eventual scarring and distortion. Thus if the granulations are "healthy" and there is sufficient tissue present for closure, the granulations are excised and the margins of the wound sutured. Direct approximation of the opposing granulating surfaces we have found to be disappointing. If the loss is too great for direct union, the granulations are sliced down to a depth depending upon the thickness of the graft to be used, and the area is skin-grafted, with the intention of later replacement with a swinging-advancement flap.

If the granulations are unhealthy or healing has come to a standstill, the wound is treated as a traumatic ulcer. The surgical aim is to remove the initiating cause of the delayed healing, such as sequestra, sloughs, foreign bodies, or constitutional faults. The fixation of the wound to the underlying parts is released, and all granulations and fibrotic tissue are excised down to good surgical material.

A pressure dressing is applied for four days, at the end of which time the wound is examined. If it is clean and sufficient tissue is present, the wound is closed. Otherwise, the surface is skin-grafted, with the intention of replacing the graft with a contiguous flap.

Following healing, the problem of scarring, deformity, and impairment of function will require reconstructive surgery, as described elsewhere.†

SUMMARY

The fundamentals of wound management in general are outlined. The treatment of wounds in the inflammatory, suppurative, and granulating stages is reviewed. To avoid

† References 23 and 24.

confusing basic issues, we have omitted discusssion of specific problems and special expedients to meet them, complicated and invasive wounds, details of technique, first aid, and constitutional and antibiotic treatment.

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Surgical Removal of Benign Nasopharyngeal Tumors

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The removal of benign tumors occurring in the nasopharynx frequently taxes the skill and ingenuity of the surgeon. The inaccessibility of the nasopharynx and the vascularity of the lesions arising here are factors which the surgeon must overcome in the successful management of these tumors.

The principal benign tumors which present themselves are nasopharyngeal fibromas and large choanal polyps. The removal of nasopharyngeal fibromas is much more serious, although the removal of polyps arising in the sphenoethmoidal recess may be attendant with severe bleeding.

Many approaches and techniques have been advocated for removal of these tumors. Direct surgical access to the nasopharynx by splitting the palate has been advocated.[1] This technique occasionally leaves an opening in the palate which is difficult to close. Attempts to avulse the tumors by grasping them with large uterine tenaculi by a retrograde approach have been suggested. This method often results in incomplete removal of the tumor. Transalveolar, transantral, and lateral rhinotomy approaches have been advocated, but frequently leave deformities.[2]

Because of these difficulties, I have recently used a combined intranasal and postnasal approach in removing both nasopharyngeal fibromata and excessively large nasopharyngeal polyps.

The procedure is performed, with the patient under a general anesthetic, using combined intravenous thiopental (Pentothal) sodium and intratracheal intubation. There is more difficulty involved in working in the nasopharynx with an oral intubation tube in place, but the advantages easily outweigh the disadvantage of working around the tube.

A small Levin tube, No. 12 F., is passed along the floor of the nose on the side in which the tumor arises and lies. A heavy silk thread is tied to the distal end of the Levin tube, the other end being fastened to a loop of No. 4 polyp snare wire which has been cut with equal arm lengths of 8 in. (20 cm.). The Levin tube is then pulled through the nose into the oropharynx until the wire loop is visualized by retracting the palate. The loop of wire is then delivered into the oropharynx. The two distal ends of the wire, now protruding from the anterior nares, are then passed through an insulated metal tube, similar to that of a Cameron electric cautery snare or a specially prepared Krause polypectomy snare. The metal tube is passed over the two arms of the wire loop along the floor of the nose by direct vision, so that little damage to soft tissue is encountered. The tip of the tube is placed at the opening of the posterior choana on the involved side.

The two ends of snare wire are then grasped with a large curved hemostat and twisted so that a secure, firm hold can be maintained. The loop of the wire presenting in the oropharynx is then grasped by another hemostat. The soft palate is elevated by a Love or Lathrop retractor, and the wire loop is then passed over the superior surface of the tumor. The tumor then lies between the wire loop and the opening of the insulated metal tube at the choanal opening.

An assistant then firmly grasps the metal catheter and supports it strongly. A cautery tip is then applied to the point where the

wire arms are being grasped by the hemostat. The cautery is turned up to 35 or 40 ma. cutting current. By pulling the snare wire firmly with the hemostat in a direct line of pull, the wire loop then resects the tumor as close to its base as possible. The loop is firmly pulled until it is delivered through the metal tube, just as in an ordinary polypectomy snare.

The resected tumor is now visualized by retracting the palate, and is removed by grasping it with a suitable forceps. Any remaining residual tumor can then be visualized in the nasopharynx, just as in performing a direct-vision adenoidectomy. The tumor residuum is removed down to the underlying periosteum by biting forceps. Bleeding points can be isolated and coagulated. If persistent bleeding is present and cannot be controlled by cauterization, a postnasal pack will usually control it within one or two days. Ligation of major arteries has not been found to be necessary to control bleeding in these cases.

SUMMARY

Removal of benign nasopharyngeal tumors is often difficult, tedious, and incomplete. Various procedures have been advocated for the surgical treatment of these conditions. A combined intranasal and postpalatal approach is described. It has proved to be satisfactory and has simplified surgical removal of the principal benign tumors arising in the nasopharynx.

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Clinical Notes, New Instruments and Techniques

MODIFIED SOFT EAR INSERT

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Twenty-one selected patients were tested at the Audiology and Speech Correction Center, Walter Reed Army Hospital, with a modified soft plastic ear insert which is fitted into the hearing-aid receiver, and the findings were compared with the results of tests done with a standard soft insert.[1] Although there appeared to be no significant difference in speech reception and speech discrimination while the patient was using one or the other insert, the modified insert made manifest the advantages of added comfort to the patient, less fabrication time, and lower cost. Because of these positive results, the improved insert, which is made with an open channel, now replaces its predecessor, the standard soft insert, and is issued at Walter Reed Army Hospital to each patient requiring a hearing aid. Figures 1, 2, and 3 show the three stages of ear inserts, which have been used successively at Walter Reed Army Hospital since 1946. Figure 4 shows a modified soft insert in position in the ear.

The following criteria determined who were the patients to be selected: (1) The hearing loss had to be greater than 30 db.; (2) hearing-test results had to be consistent; (3) there could be no language problem.

Two soft ear inserts, one constructed with a tube (Fig. 2) and one with an open channel (Fig. 3), were made for each patient. Nine of the patients had a conductive hearing loss; 10 had a perceptive loss; 2 had a mixed loss, predominantly conductive.

The patients were asked to give each ear insert a three-day trial. Then with each of the two inserts tests were administered to evaluate hearing-aid performance for speech-reception threshold and speech discrimination. The patient's subjective opinion of each insert was obtained by means of a questionnaire; of the 21 patients tested, 20 favored the tubeless insert.

An electronic analysis showed the frequency-response curves (Figs. 5 and 6) of each insert. A flat hearing-aid receiver and a capacity microphone, coupled through the insert, were utilized in the objective testing of each insert. The output of this "artificial ear" was fed into a Panoramic analyzer. The analyzer showed frequency and logarithmic intensity on the face of the oscilloscope. The constantly changing pure tone was introduced into the hearing-aid receiver at a constant level. The result was an accurate frequency-intensity picture displayed on the face of the oscilloscope. As indicated in Figure 6, removing the tube of the ear insert resulted in a miniature Hemholtz resonator. The resonant frequency occurred in that area of the auditory spectrum which may contribute somewhat to improving the intelligibility of speech. The exact frequency of resonance was dependent on the volume of air within the tubeless insert.

The speech-reception threshold and speech-discrimination tests were given in a soundproof room. Recorded speech was channeled through a loud speaker from the control room into the test room. The speech-reception thresholds were established with Harvard University's Psycho-Acoustic Laboratory (PAL) Auditory Test No. 14, spondee word lists 5A and 5B; and the speech-discrimination tests were administered with Central Institute for the Deaf (C. I. D.) Auditory Test W-22, using phonetically balanced word lists 1E, 2E, 1F, and 2F.[2]

Each patient was asked to adjust the volume of his hearing aid to a comfort level setting of 40-db. speech input. The volume control then remained constant throughout the testing period, and the inserts were tested in random order. An assistant placed the insert in the patient's ear, and the tester did not know in which order the two inserts were tested until the completion of the test.

With respect to speech-reception thresholds, the insert without a tube provided speech-reception thresholds which averaged 0.2 db. better than those obtained with the standard ear insert. Also, speech-discrimination scores averaged 0.5% better when the insert without a tube was used. Obviously, these differences were so small, from both a practical and a statistical standpoint, that one could readily say one insert was as good as the other for speech reception and speech discrimination. However, the open-channel insert was found to have the following advantages over the standard soft insert: (1) It was more comfortable; (2) it took one-half hour less time to make; (3) it cost less money.

Director, Audiology and Speech Correction Center, Walter Reed Army Hospital, Washington 12, D. C. (Major Albrite). Director of Research, Subcommittee on Noise in Industry, Committee on Conservation of Hearing, American Academy of Ophthalmology and Otolaryngology (Dr. Glorig).

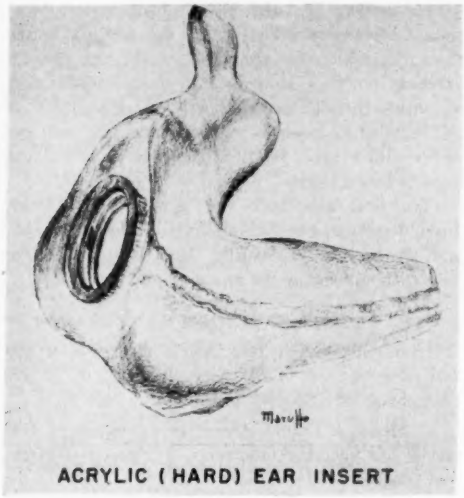


Figure 1.

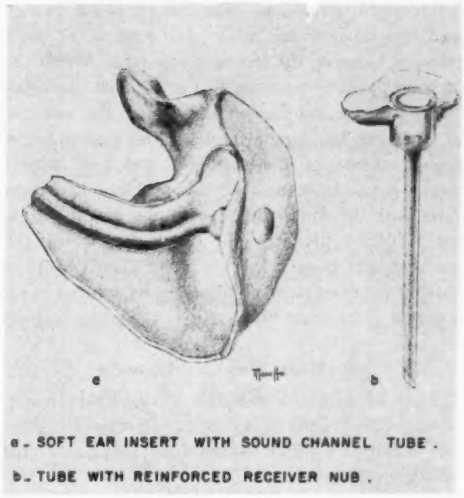
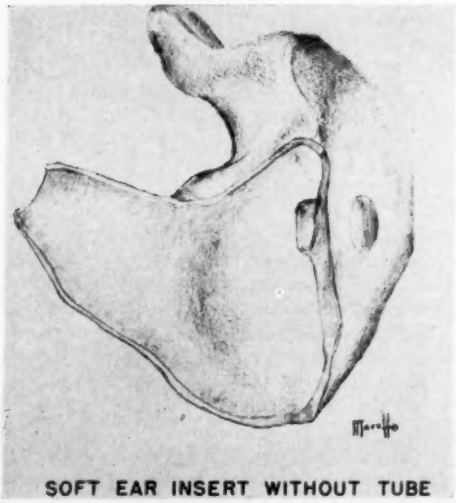


Figure 2.



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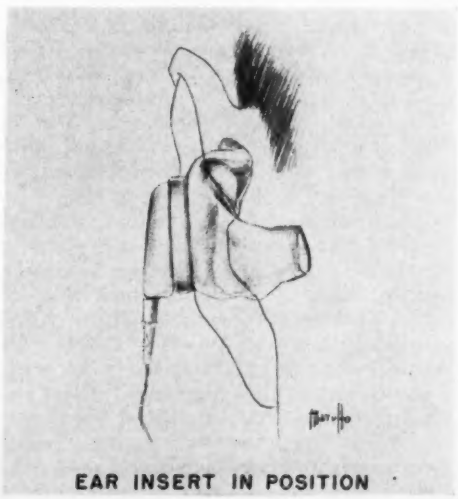

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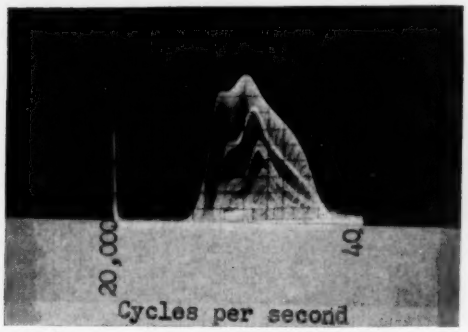

Fig. 5.—Frequency-response curves with the use of the standard soft ear insert (with tube).

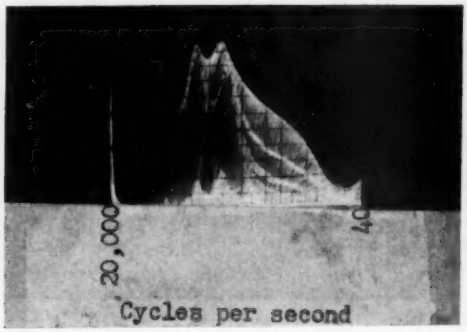

Fig. 6.—Frequency-response curves with the use of the modified soft ear insert (without tube).

Except for having an open channel and a thinner wall, the tubeless ear insert was constructed basically the same as the standard soft insert. With respect to the latter, sealing of the variable space between the tube and the canal tip caused the material in that area to become hardened, so that in some cases soreness of the ear developed and adjustments had to be made; but this problem was overcome with the elimination of the tube, and the canal tip remained pliable. The open channel of the modified soft plastic insert was sufficiently wide in most instances to enable cleaning its interior with a cotton swab.

SUMMARY AND CONCLUSIONS

The Audiology and Speech Correction Center, Walter Reed Army Hospital, has developed a tubeless soft insert which replaces the previously used standard soft insert.

Speech-reception and speech-discrimination results with the modified insert are slightly better than those with the standard insert; but from a practical point of view in this respect, one insert is considered to be as good as the other.

The tubeless insert is more comfortable than the insert with a tube; it takes less time to make, and it costs less money.

Technical assistance was given by Miss. M. Josephine Walker, Mr. Maurice B. Whitlock Jr., and Mr. Stanton E. Sheltra. Mrs. Jessie H. Evjen helped in preparing the manuscript.

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REPAIR OF PAROTID FISTULA

A Case Report

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Though infrequent, parotid fistula, when it does occur, presents a challenging problem in management. This is so especially if one desires to maintain the function of the gland rather than resort to its ablation by either surgical or radiological means. The literature of the past 25 years includes relatively few papers on this subject. The treatment recommended in these falls conveniently into the following categories:

I. Irradiation of the parotid gland
II. Surgical treatment
  A. Use of an intraductal dowel
    1. Silkworm gut, horse hair, silk, etc.
    2. Metals *
    3. Ureteral catheters †
  B. Excision of fistula
  C. Interruption of auriculotemporal nerve

Since the secretory component of the parotid gland is relatively sensitive to roentgen rays, only small doses are necessary to obtain temporary suppression of function. However, large doses are required to produce an absolute destruction of secretory activity,‡ such as would be necessary in a patient with complete interruption of the major duct.

Of surgical methods, the mere excision of the external fistula, with or without a fascia lata graft to close the dehiscence in the parotid capsule,[7] is patently inadequate so long as the parotid secretion is provided no pathway of egress into the mouth. The surgical interruption of the auriculotemporal nerve,[8] which carries the secretomotor fibers from the otic ganglion to the parotid gland, likewise fails to solve the problem. On the other hand, the attempt to reestablish the continuity of the duct is most logical and satisfactory when feasible, that is, when a considerable hiatus does not exist between the proximal and distal portions of the interrupted duct. Various materials have been used as dowels for threading the duct. Glascock and Glascock described their ingenious method, using silkworm gut, in 1937.[9]

In the following case a parotid fistula was treated successfully by creating a new opening through the buccinator muscle, other than that of Stensen's duct, for the drainage of saliva into the mouth.

REPORT OF CASE

S. S., aged 57, was examined on March 20, 1952. He complained of a swelling in his left cheek, which caused him some discomfort, and which had been present for two and one-half years without any appreciable change in size. A mass, 2 cm. in diameter, firm and freely movable, was located about 4 cm. anterior to the tragus and about 2.5 cm. below the zygomatic arch. Ear, nose, and throat examination was otherwise entirely normal, including the openings of both parotid ducts. A diagnosis of "probable mixed tumor" was made, and excision of the mass was advised.

The patient was operated on March 22, 1952. An incision, 4 cm. long, was made over the mass and parallel to the parotid duct. The tumor was found in the accessory lobe of the parotid gland, and it appeared to be well encapsulated. Several branches of the facial nerve were intimately incorporated in the capsule of the tumor and were freed by careful dissection. The tendinous portion of the masseter muscle and its anterior border were clearly demonstrable. The tumor and its capsule were removed completely, including a crescent of parotid gland posterior to the mass. This crescent, because it was of firmer consistency than normal parotid, was included in the excised specimen. A Penrose drain was inserted and the wound closed in layers.

The pathological diagnosis of the specimen was "mucoepidermoid variant of mixed salivary gland tumor."

After surgery, the face in the operated on region gradually became very tense and swollen after the removal of the drain on the second postoperative day. On the fifth postoperative day the wound was opened, allowing salivary secretion to drain out. On the following day irrigation with sterile saline through the opening of Stensen's duct in the mouth caused the solution to pour through the fistula in the cheek. This confirmed the fact that the external fistula represented a complete bypass of the major parotid duct, the missing portion of the duct having been included of necessity in the specimen removed from the accessory lobe.

From the Departments of Otolaryngology of the College of Medical Evangelists and the University of Southern California.

* References 1 and 2.

† References 3 and 4.

‡ References 5 and 6.

The problem was now one of a complete external parotid fistula with a sizable deficiency in the duct. Because of this deficiency, the possibility of using a dowel over which to reunite the duct was discarded as impracticable. Before resorting to irradiation, it was decided to try to establish a new fistula into the mouth through the buccinator muscle, an analogy having been drawn from the use of setons in the treatment of ranulas.

With this in mind, on March 31, 1952, a U-shaped No. 7 stainless steel wire (size of tonsil wire) was inserted through the external fistula, through the buccinator muscle, and through the mucosa of the cheek. The mucosa was pierced at two points, about 6 mm. apart, near the normal opening of the parotid duct. The loop of wire was buried deep in the soft tissues and disappeared from view through the external fistula. On the inside of the cheek, the two free ends of the wire were wound together to form a ring.

The flow of saliva through the external fistulous opening rapidly diminished, and by Apirl 8, 1952, this opening had completely closed, and the saliva was entering into the oral cavity around the wires. Ten days later the wire was removed through the mouth. The patient has since been observed for a period of two and one-half years. There has been no evidence of recurrence of the tumor, and the saliva drains into the mouth through an opening about 1 cm. below the natural opening of Stensen's duct.

COMMENT

This report is presented primarily to describe a method of dealing with a parotid fistula. We also desire to reaffirm our present conviction that any tumor of the parotid should be treated by total excision, not only of the mass and its pseudocapsule but of an adequate margin of surrounding parenchyma. Were the patient here described to present himself to us now, the entire superficial lobe of the parotid would be removed, after a complete dissection of the branches of the facial nerve.

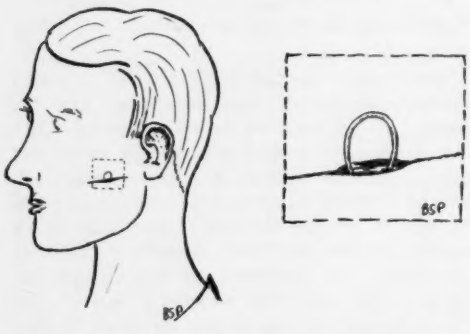

Fig. 1.—Location of postoperative fistula, with wire shown before being drawn into the fistula.

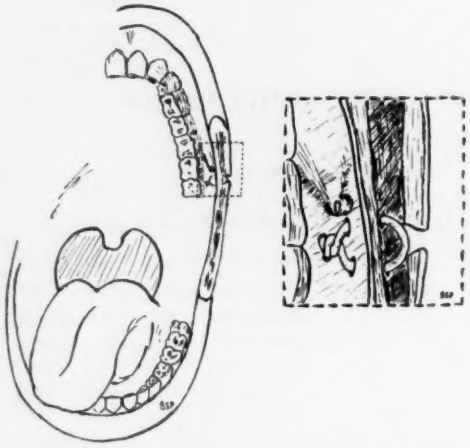

Fig. 2.—Cross section of cheek showing wire drawn into fistula and twisted together to make a ring. The normal parotid orifice is seen immediately above the crossed ends of the wire.

SUMMARY

A case history is presented in which a postoperative parotid fistula was successfully treated by creating a new duct and a new opening into the mouth.

1917 Wilshire Blvd.
6317 Wilshire Blvd.

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Progress in Otolaryngology

BRONCHOESOPHAGOLOGY

Summaries of the Bibliographic Material Available in the Field of Otolaryngology

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NEWER developments of current interest in the literature during the past year dealt principally with the esophagus, particularly varices and strictures. Physiologic data on esophageal motility and pressure measurements in dilated veins were studied extensively. The management of esophageal strictures received considerable attention, and while the role of cortisone in acute burns was investigated, the question of its usefulness is still unsettled.

ANATOMY

Rios-Solans [1] could demonstrate no clearly defined anatomical sphincter at the lower end of the esophagus, and the squamous lining was found to end in an irregular curve, and not in a ring. This does not exclude a broad but weak contractile mechanism in the lower part of the esophagus. In an unselected series of adults examined at necropsy, patency of the hiatus was demonstrated in 26%. This finding was interpreted as evidence of a potential hiatus hernia. The patency was always found at the anterior and left lateral part of the passage of the esophagus through the diaphragm.

PHYSIOLOGY

Hilding [2] studied experimentally the development of postoperative pulmonary atelectasis. Atelectasis occurred after the removal of air from a portion of the lung which was isolated from atmospheric pressure. Absorption took place continuously, but the ciliary action and moving masses of mucus were the chief factors in the production of postoperative atelectasis. The sole mechanism maintaining the negative pressure when the mucus is soft was ciliary action.

Overholt and his associates [3] presented the results of postoperative pulmonary function studies after segmental resection for bilateral and unilateral bronchiectasis. In a comparison of function of the normal lung with that of the operative side, it was found that oxygen consumption and ventilation increased with the number of segments conserved, which emphasized the importance of the segments as a unit of excision in treating bronchiectasis.

Motor mechanisms of the esophagus, with particular reference to the distal portion, were studied with pressure recording apparatus and simultaneous fluoroscopy by Sanchez and his associates.[4] In the upper seven-eighths of the esophagus the swallowing complex was found to consist of two major components: an immediate slight elevation of pressure and a later higher pressure wave produced by peristaltic contraction of the esophageal lumen. During repeated swallowing the peristaltic pressure wave was inhibited until after the last swallow. In the distal esophagus two different types of swallowing complexes were found in the anatomical regions of the ampulla and the vestibule. In the ampulla the pressure created by peristalsis fell more gradually than in the upper esophagus. The initial pressure rise following immediately upon swallowing was not transmitted into the vestibule, and the usual peristaltic pressure wave did not occur in this area. This distinct motor phenomenon of the distal esophagus may play a role in the benign clinical disorders of this area.

Kay [5] called attention to the lack of knowledge relative to the anatomy and physiology of the lower esophagus. It was suggested that either spasm or hypertrophy of the inferior esophageal constrictor could cause functional stenosis and be a factor in the production of

functional dysphagia, Plummer-Vinson syndrome, esophageal spasm, achalasia, pulsion diverticulae of the thoracic esophagus, and the idiopathic strictures of the terminal esophagus. The etiology of spasm or hypertrophy could not be explained but was thought to be similar to that of circular musculature in other smooth-muscle sphincters of the body. Experimental and clinical evidence suggested that this spasm and hypertrophy resulted from a preponderance of sympathetic control. It was postulated that when there is a predominance of sympathetic control, such as might occur when there is degeneration or absence of the ganglion cells of Auerbach's plexus or the vagus nerves, muscular coordination is impossible, and the circular fibers of the inferior esophageal constrictor not only become contracted and hypertrophied to the degree of causing esophageal obstruction but also fail to relax and dilate before the oncoming esophageal peristaltic wave, with resulting functional obstruction.

ANESTHESIA

Rego [6] reviewed his results in 700 endoscopic cases. Local anesthesia with tetracaine (Neo-Tutocain) was preferred. General anesthesia was not employed, and in children under 4 years of age not even local analgesia was used. No accidents occurred with the medications employed. The importance of the psychological preparation of the patient was stressed.

Rubin [7] listed the untoward reactions to topical anesthetic agents and considered them due to an excessive amount of the drug, too rapid instillation, or failure to perform suitable preliminary tests for sensitivity. Three hundred milligrams of cocaine or 50 mg. of tetracaine proved satisfactory in combining anesthetic potency and ample volume with safety. These quantities should be accurately measured for every patient and never exceeded, for the basis of any technique is careful measurement of the total dosage and strict adherence to that amount. For those adults in whom general anesthesia was desired, the combination of thiopental sodium and curare or a curarizing agent usually proved satisfactory.

Ament and Meyers [8] were of the opinion that the anesthetic combination of thiopental sodium, succinylcholine chloride, and topically applied tetracaine most nearly fulfilled the requirements for an ideal anesthetic for peroral endoscopy. Most of the 50 endoscopic procedures were performed with minimal doses of thiopental sodium, ranging from 250 to 400 mg., and of succinylcholine chloride, ranging from 25 to 40 mg. The chief advantages were thought to lie in the rapid return to consciousness of the anesthetized patient and the return of adequate activity of the respiratory musculature together with better ability to handle the secretions and blood incidental to the endoscopic procedures. While the use of intravenous anesthetic agents eliminated the danger of explosion and facilitated the maintenance of the desired level of anesthesia, it also prolonged the postoperative depression and introduced the serious danger of laryngospasm.

Mathieu and Crandell [9] employed tripelennamine (Pyribenzamine) hydrochloride in a 4% solution as a topical anesthetic agent for bronchoscopy in 12 cases. There were two untoward reactions due to toxic effects of the drug. Because of an unpleasant burning sensation, increased salivation, and inability to obtain consistently adequate anesthesia, tripelennamine hydrochloride alone in the strength used proved unsatisfactory. While it has made possible the use of smaller doses of cocaine than would otherwise have been possible if cocaine had been used alone, the occurrence of untoward reactions does not seem to justify the use of tripelennamine hydrochloride.

The cricothyroid route for anesthesia for bronchoscopy was used in 350 consecutive cases by Schaff and Todd.[10] With a No. 20 gauge needle, 5 cc. of a 5% solution of cocaine was injected through the cricothyroid membrane after the skin was first anesthetized with 1% procaine solution. About 5% of the patients required supplementary doses of the cocaine solution after introduction of the bronchoscope. Adequate anesthesia was

obtained. There was no evidence of infection in the neck or along the needle track, and the only objection listed was an occasional patient in whom blood-tinged sputum was noted after the instillation of the anesthetic solution. In determining the site of hemoptysis bronchoscopically, this additional blood could easily complicate the picture.

An antiemetic mixture (Apolamine) was used in a large series of cases as a preliminary medication for laryngoscopy, bronchoscopy, and esophagoscopy by Holinger and his associates [11] to prevent nausea and vomiting. The clinical impression of the action of this agent has been favorable, although records based upon patients' reactions are subject to possible error and there were no controls in this series. The occurrence of nausea and vomiting before, during, or after peroral endoscopic procedures using the preoperative medication of morphine, atropine, and phenobarbital sodium and local anesthesia with tetracaine (Pontocaine), 2%, and cocaine, 10%, was approximately 11%, whereas in the series in which Apolamine was added the percentage rate dropped to 4%. No undesirable side-action was noted. Apolamine consists of atropine sulfate, scopolamine hydrobromide, phenobarbital, ethyl aminobenzoate (Benzocaine), pyridoxine, nicotinamide, and riboflavin.

COMPLICATIONS OF ENDOTRACHEAL ANESTHESIA

Jackson [12] cited the reasons for the development of contact ulcer granuloma on the tip of the vocal process of one or both arytenoids. Since the arytenoids are constantly moving, the thin mucoperichondrial covering of the prominent vocal processes are forcibly projected inward and impinge upon each other. The movements of the larynx are not abolished by surgical anesthesia, and when an endotracheal tube is in position, the tips of the vocal processes are rubbed to and fro on the tube. When the trauma to the mucoperichondrium is sufficient a contact ulcer develops, and when healing is delayed granuloma formation occurs. The trauma sustained by the vocal processes was attributed to the contact with the indwelling tube as well as trauma at intubation. Contact ulcer granuloma may be incidental to endotracheal anesthesia or due to other causes, but when early diagnosis and proper treatment are instituted the prognosis is good.

The following prophylactic measures to prevent laryngeal granuloma after endotracheal anesthesia were suggested by Barton [13]: avoidance of a sharply flexed head position, forcing a tube through a laryngeal spasm, the use of a large tube, extralaryngeal trauma during operations, and the use of sterile technique for intubation and antibiotic therapy postoperatively.

Another case of postintubation laryngeal granuloma was added to the literature by Heller.[14]

Endelman [15] recorded a case of perforation of the pyriform sinus following blind endotracheal intubation.

CONGENITAL ANOMALIES

Congenital vascular anomalies as causes of tracheal and esophageal compression were discussed by Scott and Daniel.[16] Death may occur from sudden occlusion of the already narrow trachea or from obstructive bronchitis and pneumonitis when vascular anomalies with obstruction to the trachea and esophagus are overlooked. Tracheal compression by a vascular ring may be erroneously diagnosed as congenital laryngeal stridor or in the event of a superimposed pulmonary infection as a simple laryngotracheobronchitis. Careful direct examination of the larynx and roentgen examination of the barium-filled esophagus should be carried out without general anesthesia because of the greatly increased anesthetic risk imposed by the presence of respiratory obstruction in all infants and children who have persistent or frequently recurring symptoms suggestive of tracheal or esophageal obstruction. Following operation for the correction of obstruction from anomalous vessels, relief of symptoms may be instantaneous and dramatic. In some other cases the wheezing type of respiration may persist for days or even for several weeks, usually with progressive improvement and ultimate

disappearance of disability. When this occurs the pressure deformity of the tracheal cartilage disappears after removal of the source of extrinsic compression, and with the continued growth of the child. Complete relief from disabling symptoms might not occur in patients who have other associated cardiovascular anomalies, such as pulmonic stenosis, but the great majority of cases of vascular rings with obstructive symptoms have not been associated with other significant cardiac abnormalities.

A case of agenesis of the lung with no trace of the lung, bronchus, or vascular supply on the right side was reported by Oyamada and his associates.[17] A clinical diagnosis can usually be strongly suspected on the basis of the physical findings, roentgen and fluoroscopic findings. Bronchoscopic examination, with bronchography and angiocardiography, may be necessary to establish the diagnosis, but because of the danger connected with these procedures in this condition, they should be done only after clinical evaluation of each individual case and then only by experienced bronchoscopists.

A case of agenesis of one lung with respiratory difficulty and death caused by vascular compression of the airway was reported by Maier and Gould.[18] An anomalous course of the pulmonary artery and the position of the aorta were responsible for the tracheal narrowing.

A case of congenital absence of the trachea with a bronchoesophageal fistula was reported by Kessel and Smith.[19] There was no adequate respiratory function, so that the child died shortly after birth, but necropsy disclosed normal lung development.

A case of atresia of the esophagus with an abnormal tracheal fold was reported by Franklin and Graham.[20] This abnormal valvelike fold in the trachea was quite mobile and presumably capable of movement with the passage of air on respiration. Its ball-valve obstructive mechanism in the trachea produced cyanosis and stridor. Investigation of the stridor by preoperative bronchoscopy might have revealed the abnormality and improved the prognosis.

FOREIGN BODIES IN THE AIR AND FOOD PASSAGES

A series of consecutive cases consisting of 53 cases of esophageal foreign bodies and 17 foreign bodies in the air passages was reported by Hung and Lin.[21] A recent increase in the incidence of foreign bodies in the air and food passages was noted in Taiwan. Of the esophageal foreign bodies, bones were the commonest, with frequent complications, such as periesophagitis or periesophageal abscess. Of the foreign bodies in the air passages, peanuts were most often observed. The prognosis in foreign-body accidents has improved because of better endoscopic technique, the use of antibiotics, and the increased awareness of physicians and the general population to the dangers of foreign bodies.

TRACHEAL TRAUMA

Two cases of subcutaneous injury of the trachea in children who received two divergent but equally successful lines of treatment were reported by Metson.[22] In one case successful conservative management was followed and the perforation closed spontaneously. When the conservative course was followed, careful watch was maintained on the pulse rate, respiratory rate, and blood pressure for evidence of change which might indicate extension of the mediastinal emphysema or the development of a pneumothorax, which require more active treatment. In the second case, which was more severe, a tracheotomy was performed as a decompression procedure, converting a closed injury into an open one. This procedure was sufficient to release the pressure and to prevent any increase in the air blockage, since the tracheotomy was performed below the site of obstruction and tear.

TRACHEAL STENOSIS

A case of tracheal obstruction from benign lymphoid hyperplasia in the tracheal mucosa of a 2½-year-old child was reported by Olson.[23] The symptoms were those of gasping for breath during exercise, a change in the voice, and noisy breathing while sleeping. Endoscopic examination revealed a rounded,

smooth, nonulcerative mass of firm consistency, with a broad base on the posterior wall of the trachea, just below the cricoid level. Following repeated biopsies, the pathologic diagnosis was consistently lymphoid hyperplasia. It was thought that this unusually large lymphoid deposit had grown in response to minor infections in the upper respiratory tract, and marked improvement followed endoscopic removal of the mass.

MacRae and his associates [24] reported a case of severe tuberculous stenosis of the trachea, which underwent marked clinical improvement after repeated incisions with a knife especially designed for use through a bronchoscope. A knife was used rather than a cautery, since it was feared that the reaction to the cautery might seriously increase the degree of stenosis. This method of treatment was also decided upon because of the high mortality rate associated with surgical removal and repair of the lower end of the trachea. In the surgical incision of the stenosis, cuts were made approximately at one and at four o'clock, so that a small triangular flap of tissue could be released and treated with 30% silver nitrate. The procedure was repeated on several occasions.

A case of tracheopathia osteoplastica, with the typical endoscopic picture, was presented by Lell.[25] In the lower trachea there was noted a conical narrowing, while on the anterior wall of the trachea tiny blunt projections with spicule-like arrangements covered by moderately inflamed mucous membrane were observed. When the tip of the bronchoscope was passed over these irregular elevations, a brittle scraping sensation was felt. The changes extended into the lumen of the right and left main bronchi, where the walls were fixed and hard.

TRACHEAL IMPLANTS

Pressman [26] reported on the experimental work done to construct a suitable tracheal implant. The problem is difficult to solve, but certain accomplishments have been achieved. First, large tracheal defects have been repaired by the use of decalcified bone patches and other materials. Secondly, the vascular anatomy has been found to be of prime importance in the repair of any tracheal defect. Thirdly, while a fibrous tube lined with mucosa has been constructed, it has not yet been learned how to provide it with adequate rigidity. Present experimental work is directed toward reconstructing a rigid pseudotrachea lined with ciliated epithelium. Nonrigid epithelium-lined tubes are being kept open by temporary polyethylene molds within their lumens and various coarsely woven meshes, such as stainless steel and tantalum, and flexible nylons are being utilized as wrap-arounds. It now appears that these previously flaccid tubes will adhere to the rigid or semirigid mesh and remain patent, enabling a rigid epithelium-lined tube to be successfully reconstructed.

TRACHEAL TUMORS

Gilbert and his associates [27] could find only 43 cases of primary tracheal tumors in infants and children reported in the literature. In contrast, 503 tumors in adults have been reported. In children approximately 93% of the tumors were benign, whereas in the adult approximately 50% were malignant. Only three malignant tumors were reported in children, all of them occurring in infant girls, and all were sarcomas. The predominant benign tumors of childhood, in the order of their frequency, were papilloma, fibroma, and angioma. In the adult, carcinoma was the predominant form of malignancy, and in the benign cases osteochondroma, papilloma, and fibroma were most frequently encountered. The symptomatology depended upon (1) site of the tumor, (2) type of attachment, and (3) size of the tumor and width of the trachea. Removal of the benign tumors, either through the bronchoscope or by open operation, gave satisfactory results. Malignant tumors of the trachea amenable to surgery required open operation.

Two cases of multiple papillomas of the trachea with malignant degeneration were reported by Ogilvie.[28] The scarcity of physical findings of tracheal papilloma in the early stages creates a difficult problem in early diagnosis. In uncomplicated tumors, signs

and symptoms remain absent until the growth is sufficiently large to produce obstruction. Probably the earliest sign is a wheeze followed by definite stridor and, later, secondary changes in the distal parts of the tracheobronchial tree secondary to the obstruction. The correct diagnosis can usually be made by following an orderly procedure, which includes an accurate clinical history, a general physical examination, routine laboratory tests, roentgen-ray examination, bronchoscopic examination, and biopsy, with histologic study of the excised specimen. For papillomas, as illustrated in the two cases reported in which there was evidence of malignant degeneration and in one metastasis to the peritracheal lymph nodes, radical treatment is indicated. The type of therapy must be fitted to the individual case, but local excision combined with fulguration or cauterization of the base, with or without irradiation, should be considered. It is necessary to observe these patients over a prolonged period in order to detect recurrence or new papillomas.

A case of myosarcoma of the trachea that originated from the anterior wall and grew into the lumen was reported by McKenzie and Rezek.[29] This tumor was associated with changes of the thyroid gland, which were considered to indicate a Riedel struma. These tumors are rare in occurrence, and the unusual features of this case were origination from the anterior tracheal wall, for the majority arise from the posterior or the lateral wall, and the association with Riedel struma.

ENDOSCOPY

Boyce[30] specified that the endoscopist should be surgically minded, since a major portion of endoscopic work is concerned with malignant disease. Carcinoma of the esophagus will remain in its present unhappy state unless esophagoscopy is done on any patient who presents evidence of disordered esophageal function, no matter how slight it may be. Esophagoscopy is indicated if there is any doubt as to the origin of hemorrhage from the upper gastrointestinal tract, and esophageal varices do not constitute a contraindication to this procedure. Bronchoscopy has an important place in the preoperative and postoperative management of surgical cases. The elimination of material in the chest before operation makes the formation of bronchial plugs after operation less likely. Bronchoscopy should not be delayed when there is evidence of any degree of atelectasis which does not promptly respond to conservative therapy. Bronchoscopy is a useful diagnostic measure in bronchiectasis, lung abscess, and tuberculosis, but its widest field of usefulness is in the diagnosis of carcinoma of the lung. When bronchoscopic biopsy is positive or malignant cells are found in the bronchial secretions, the diagnosis is established, but negative bronchoscopic findings in clinically suspicious cases have to be accepted with reserve. A more careful interpretation of roentgenograms, a more liberal interpretation of bronchoscopic observations, even if they are not pathologically positive for cancer, and an earlier exploration of the chest on suspicion alone would change the outlook in carcinoma of the lung for the better. Advanced cardiovascular disease and aortic aneurysm would seem to be the only absolute contraindications to bronchoscopic investigation.

The frequent use of endoscopic procedures in infants and young children was encouraged by Cracovaner.[31] With proper training and skill and adequate instruments there is little danger to the patient. After instrumentation, there is always the possibility of subglottic edema that may necessitate a tracheotomy, but this can be largely overcome by gentle manipulation and the use of a small tube so that no trauma results. Cooperation between the obstetrician, pediatrician, roentgenologist, and endoscopist was emphasized.

Bozer[32] discussed the benefits offered by thoracic surgery in three types of cases that are commonly seen and treated by endoscopists, namely, persistent achalasia, severe strictures of the esophagus, and benign lesions of the trachea and upper portion of the main bronchi. In the vast majority endoscopic treatment has achieved excellent results, but there is a small percentage in which the

newer methods of thoracic surgery have given greater benefits. There are also borderline cases in which over a long period of time fairly good results could be obtained by endoscopic measures, but in which the effects would be much greater and quicker if surgical methods were instituted. The adoption of a more surgically minded viewpoint, with earlier thoracic surgical consultation concerning the problem cases, would seem to be warranted.

BRONCHOSCOPY IN PULMONARY DISEASE

Bronchologic aid in the diagnosis of bronchopulmonary disease was stressed by Clerf.[33] To provide this aid the bronchologist should be properly trained so that he can do bronchoscopy skillfully and with the minimum of trauma. He should be familiar with all the endobronchial aspects of bronchopulmonary disease so that he can provide a comprehensive and intelligible evaluation of the case and should be readily available when called upon. In addition to the technical knowledge of introducing endoscopic tubes, in using forceps, aspirating tubes, and other equipment, an intimate familiarity with the indications and contraindications for bronchoscopy is necessary. The occurrence of postbronchoscopic complications too often is evidence of lack of skill and judgment on the part of the bronchologist. Aside from familiarity with the anatomy, physiology, and pathology of the tracheobronchial tree, a competent bronchologist should be able to note all abnormalities, be familiar with the performance of proper biopsy, secure secretions from involved pulmonary lobes or segments, and be able to interpret for the surgeon or internist the findings that he has observed. In recent years the greatest contributions made diagnostically by bronchologists lie in the field of bronchogenic neoplasms and tuberculous tracheobronchitis. Patients with the unexplained symptoms of wheezing respiration, cough, and hemoptysis should be subjected to bronchoscopic investigation. Unexplained roentgen findings, notably obstructive emphysema or atelectasis, are fruitful fields for bronchologic investigation.

Moersch[34] stressed the indications for bronchoscopy and bronchography in pulmonary disease. In the broad sense they are indicated in any case of pulmonary disease of unexplained origin, with few contraindications.

The need for precision in bronchologic study of patients was emphasized by Priest.[35] This is made up of many small details, each as nearly perfect as possible, none important alone, but all necessary to form a precise whole. After preliminary study of the patient, careful bronchoscopic observation includes telescopic visualization of the upper lobe bronchi, aspiration of specimens, bronchial measurement, and careful bronchograms when indicated. Final disposition of the case should be made after consultation between bronchologist, radiologist, and thoracic surgeon and without undue delay so that thoracic exploration can be promptly performed when decided upon.

In performing diagnostic peroral endoscopy in patients for cardiac surgery, Maloney[36] stated that the physician performing this procedure should be aware of cardiac disease as an etiological factor in patients with typical pulmonary complaints. Bronchoscopy after, as well as before, cardiac surgery has the same indications as for any other thoracic condition, and there is no undue risk if reasonable precautions are taken.

Eeman[37] emphasized the increasing use of bronchoscopy, bronchography, endoscopic biopsy, and cytologic study of bronchial secretions in the detection of early bronchial carcinoma, but pointed out the need for continuing the education program directed at both the general public and the general practitioner.

BRONCHOSCOPIC MEASUREMENT OF CARDIAC PRESSURE

The only chamber of the heart not thus far accessible to direct pressure measurement is the left auricle. The surgical treatment of mitral stenosis has increased the need for information about the hemodynamics of the left auricle. Allison and Linden[38] reported

a direct approach and investigation of pressures in the left auricle by using a specially adapted needle on the end of a Jackson bronchoscopic aspirator to pierce the left auricle of the heart through the upper end of one of the main bronchi. The left auricle is so closely related to the esophagus behind, the bifurcation of the trachea above, and the two bronchi on each side that this method of approach was utilized. With the patient under local anesthesia the bronchoscope was passed to the region of the carina, and the needle on a cannula which was connected to a manometer and filled with saline-heparin solution was passed with the solution dripping through the anteromedial wall of the right main bronchus at the carina. A depth distance of approximately 4 cm. was necessary before the needle entered the auricle. Pressure measurements and wave forms were recorded in patients suffering from lung disease with normal hearts, and in those with mitral stenosis and mitral regurgitation. No harm came to any of the patients examined, and when operation was performed no trace of the puncture was seen except in one patient, in whom a hugh pulmonary artery was punctured by passing the needle too far forward. In this patient the only abnormality noted at operation from the examination was a slight excess of blood-stained pericardial fluid.

RESUSCITATION OF THE NEWBORN INFANT

Donlon [39] emphasized that resuscitation of the newborn can be accomplished safer and surer by using the infant laryngoscope and bronchoscope to carry out aspiration. Avoidance of trauma to either the larynx or the tracheobronchial tree is essential and can be done by proper and secure holding of the infant. The trachea and bronchi can be inspected in orderly fashion, and obstructing material may be suitably removed while a mixture of oxygen and carbon dioxide is insufflated without positive pressure. It may be possible in this way to learn the cause of the asphyxia and logically treat it at the same time. Any other method is essentially indirect, if not blind, fails to yield information necessary for immediate and future treatment, and is more likely to traumatize the larynx.

BRONCHOSPIROMETRY

Gaensler [40] reviewed his experience with 1000 bronchospirometric examinations and obtained accurate information concerning functional distribution in 89%. Incorrect positioning of the catheter was the commonest cause of poor results. Excessive premedication period, long-lasting topical anesthesia, and inadequate after-care were thought to be responsible for most febrile reactions and spreads after bronchospirometry. Because of the unusual breathing conditions, bronchospirometry should be used only as an adjunct to other pulmonary-function studies. Ulcerative tracheobronchial tuberculosis and hemoptysis within a period of two weeks were considered absolute contraindications to bronchospirometry.

In 170 cases with unilateral parenchymal disease, split-function studies performed by Gaensler and his associates [41] showed a slight reduction of respiratory participation of the involved lung, with oxygen uptake, resting ventilation, and vital capacity almost equally affected. In a group of 127 patients with unilateral pleural disease there was a striking diminution of function of the involved lung. Bronchial disease produced abnormal function only when a major bronchus was completely or almost completely occluded. The loss of function after subtotal pulmonary resection was generally equal to that after thoracoplasty of a similar extent. Decortication produced marked increase in function, provided the collapsed lung contained no parenchymal disease. The functional improvement after bronchial reconstruction was encouraging, whereas the results of autonomic nerve resection for the treatment of bronchial asthma or pulmonary emphysema were not good.

BRONCHOGRAPHY

Browne and her co-workers [42] described a method of bronchography in children under general anesthesia using thiopental (Thiopentone) sodium and gallamine triethiodide

to produce apnea. While the use of general anesthesia to the point of apnea seems drastic and unsafe, the method was used in over 200 cases, with no deaths or serious complications. Satisfactory bronchograms were regularly obtained, and there was no tendency to alveolar filling. After induction with the anesthetic agents on the roentgen table, intubation was performed perorally, secretions were aspirated, and the lungs were well aerated with oxygen. After injection of the contrast medium by a soft rubber tube threaded through a Magill endotracheal tube, the child was positioned to obtain filling of all the lobes of the lung. Throughout this procedure and the taking of roentgenograms the child is apneic, but, provided the time consumed does not exceed a minute, there is no cyanosis and no alveolar filling. As soon as the last film has been taken the lungs are inflated with oxygen and excess secretions withdrawn. The same procedure is repeated for the opposite lung, followed by inflation and aspiration.

Felton [43] found that granulomatous reaction to retained iodized oil (Lipiodol) in the lung was commoner than is generally realized, and recommended that the search for a more suitable contrast medium should continue. In 23 of 37 resected lung specimens from patients who had undergone previous iodized oil bronchography, residual iodized oil was demonstrated, the patients having received intratracheal iodized oil 23 to 295 days prior to operation. Roentgenographic evidence of retained iodized oil correlated very closely with the histologic demonstration of the material. In 16% of the lung specimens examined and in 26% of those specimens containing residual iodized oil, focal peripheral foreign-body granulomas surrounding iodized oil droplets were found. In eight specimens concentrations of iodized oil in areas of organizing pneumonitis were observed. Iodized oil when not involved in a granulomatous process was found in droplets free or phagocytized in the alveolar and bronchial lumens. There was no evidence of localization of iodized oil in lymphatics, in lymph nodes, or in bronchial walls or cartilages, and the elimination of the iodized oils seemed to be entirely by way of the tracheobronchial passages.

Asch [44] recorded the first case of acute iodism and bronchopneumonia subsequent to bronchography with chloriodized oil (Iodochlorol). The signs and symptoms occurred 24 hours after exposure to the iodide and were associated with an elevated total serum iodine level. A possibility in the case report was that a fair amount of the iodized oil was swallowed when the patient experienced gagging and difficulty during the bronchographic procedure. After digestion by the gastrointestinal enzymes, the iodine could have been liberated and absorbed into the circulation, explaining the elevated serum iodine with the resulting syndrome of acute iodism.

Park and his co-workers [45] presented a case study wherein iodism was prevented by the use of corticotropin (ACTH) prior to the intrabronchial instillation of iodized oil. It was pointed out that corticotropin has great value in diminishing the sensitivity of iodine-sensitive patients, thus preparing them for necessary diagnostic procedures where iodine-containing material must be used and other medications cannot be substituted.

Peck and associates [46] reviewed the advantages and disadvantages of the water-soluble bronchographic compounds. With the use of 50% iodopyracet in 1.75% methylcellulose (Methocel-Diodrast) satisfactory results were obtained in 66.7% of the cases. Two deaths were reported following bronchographies in which Methocel-Diodrast and 50% sodium acetrizoate in 1.75% methylcellulose (Methocel-Urokon) were used. When the results with these compounds were compared with the results secured with iodized oil, it was found that, in general, the iodized oils gave satisfactory bronchograms more consistently. With iodized oil approximately 84% satisfactory bronchograms were obtained. The difficulties with the water-soluble media seemed to be factors related to technical, toxic, and latent pulmonary changes, and while these media are valuable adjuncts in the diagnosis of pulmonary disease, they can-

not be considered the ideal agents for bronchography.

Flipse and associates [47] believed that the water-soluble contrast mediums are superior to the iodized-oil media. They are stable and completely and rapidly eliminated from the lungs. Although they possess transient local irritative qualities, they appear to be free from all systemic toxicity and can be used repeatedly in the same person. Minor modifications in the technique of bronchography, consisting of shortening the time the patient was left in each position for the obtaining of roentgenograms and decrease of the angle of the head-down positions, were necessary.

Bronchography was carried out by McSwan and Allan [48] in 18 cases with a 50% aqueous suspension of the *n*-propyl ester of 3,5-diiodo-4-pyridone-N-acetic acid with the addition of sodium carboxymethylcellulose (Dionosil). The results were not considered entirely satisfactory, but when Oily Dionosil, an arachis oil suspension of the same substance, was substituted, the results proved to be consistently satisfactory in the 50 cases tested. The contrast was satisfactory, although it was not as sharp as with iodized oil. With both preparations clearing of the lung fields occurred within 48 hours.

Katz and associates [49] pointed out the difficulties of bronchography with a water-soluble contrast medium (diethanolamine of 3,5-diiodo-4-pyridone-N-acetic acid [Umbradil]) and thought its use should be confined to selected cases in which limited bronchography suffices and in which retention of a contrast medium in the lung is especially undesirable. Iodized-oil bronchography remains the standard procedure in most cases.

McKechnie [50] performed 144 bronchograms in 111 patients with pulmonary tuberculosis using Dionosil by the cricothyroid method. No major complications were encountered. Dionosil was considered to be of more value in pulmonary tuberculosis than iodized oil because of its remarkable clearing properties. It is not, however, a perfect contrast medium because the lateral bronchogram tends to be rather faint, particularly in well-built patients. Since Dionosil coats the bronchi, it can be used with safety in patients with decreased respiratory function without leading to respiratory embarrassment from bronchial obstruction.

ACQUIRED FISTULA

DeBakey and Heaney [51] reported a case of a large tracheoesophageal fistula following an external injury not associated with fracture of the bony thoracic cage. Bronchoscopic examination revealed an elongated, linear communication between the posterior wall of the lower trachea and the esophagus. Cauterization through the bronchoscope was performed on two occasions, with little benefit, and the fistula was surgically repaired.

Johnston and Wang [52] reported a case of bronchoesophageal fistula complicating carcinoma of the esophagus occurring about one month after the patient began to have difficulty in swallowing. In addition, a paralysis of the left vocal cord had occurred before the patient developed dysphagia and the neoplasm perforated into the left bronchus.

ACUTE LARYNGOTRACHEOBRONCHITIS

In the management of acute laryngotracheobronchitis Everett [53] is of the opinion that serious obstructive problems may be prevented by the early administration of antimicrobial agents. Direct laryngoscopy is necessary if tracheotomy is contemplated so that the airway can be sucked out and its patency maintained. Bacteriologic analysis indicated that viruses have not played an important part in the pathologic picture of laryngotracheobronchitis. The possibility of an existing allergic edema of the membrane of the tracheobronchial tree should always be borne in mind and treatment directed toward this end when the edema is found.

AEROSOL THERAPY

The addition of 0.1% sodium lauryl sulfate (Duponol-C) to vaporizers or humidifiers in the treatment of acute laryngotracheobronchitis was found by Dickey [54] to produce no increase in either the relative or the absolute humidity. Any beneficial effect from this agent was the result of its action on the respiratory secretions. The action of 0.1%

sodium lauryl sulfate on the two types of mucin used for study was negligible except for the findings on surface tension and penetration. The surface tension was reduced, and the respiratory mucin was liquefied.

Seventy-three patients with respiratory conditions, with or without thick viscid sputum, were treated with trypsin in aerosol form by Unger and Unger.[55] This enzyme proved to be nontoxic and did not affect living tissue while lessening the viscosity of the sputum. It is a safe preparation to administer, and the only troublesome side-effect was hoarseness. Inhalations of aerosol trypsin were extremely effective in ridding the upper part of the respiratory tract of thick sputum that the patient was unable to expectorate. Excellent results were obtained in most patients with bronchiectasis, acute atelectasis, and bronchial asthma complicated with bronchitis or pneumonitis. Good results were also secured in paroxysmal bronchial asthma, but the majority of patients with chronic bronchial asthma and emphysema received little or no relief.

Two cases of persistent atelectasis of the newborn were treated with aerosol trypsin by Balthrop and Hicks,[56] with beneficial results. About 30 minutes after the use of aerosol trypsin, the mucus in the pharynx became profuse, liquefied, and fluent, necessitating frequent pharyngeal suction for the following several hours. At the same time the collapsed lung expanded, and in eight hours the lung fields appeared normal. Studies were presented to demonstrate the viscosity-reducing and protein-digesting action of trypsin on respiratory mucus.

A patient with obstructive atelectasis in whom bronchoscopic aspiration was considered hazardous but who recovered after the use of aerosol crystalline trypsin was reported by Craven.[57] It was suggested that the intrabronchial instillation of the appropriate proteolytic enzyme in conjunction with suction might result in more complete removal of the obstructing exudate.

Aerosol trypsin therapy was found to be beneficial by Varga and Wild [58] in the treatment of a child with bulbar poliomyelitis complicated by respiratory difficulty despite a tracheotomy. The accumulation of extremely tenacious mucus was rendered more fluid, making aspirations easier and more effective.

HEMOPTYSIS

MacHale [59] recommended that all patients with unexplained hemoptysis have a bronchoscopic examination. Of 109 patients with this presenting symptom of hemoptysis, 71 had no clinical or roentgenologic evidence of disease, but 4 of these were found to have tumors visible on bronchoscopy. Sixty-seven patients with no bronchoscopic evidence of disease were followed one to four years after the examination. One was found to have carcinoma of the bronchus. Although it was recommended that initial bronchoscopies be done on all cases of hemoptysis, it was not felt that reexamination should be done at later dates when the initial bronchoscopy proved to be negative.

Two cases of Rendu-Osler disease with bronchial involvement were reported by Mounier-Kuhn.[60] Bronchoscopy performed because of recurrent hemoptysis revealed red spots and telangiectasis in the mucosa. Since this was the source of the hemorrhage, local treatment of the diffuse capillary enlargement was considered useless.

ATELECTASIS

Woolley [61] described a case of fibrinous bronchitis producing total collapse of the right lung from a large tree-like cast. The patient died, without the benefit of a bronchoscopy, of asphyxia due to rapid occlusion of the opposite bronchial orifice at the carina.

A case of atelectasis of the right middle lobe caused by the presence of a large foreign body in the lower third of the esophagus was reported by Valle and Cloudier.[62] The syndrome was produced by the presence of a denture in the lower third of the esophagus, and after the foreign body was removed the atelectasis cleared.

BRONCHIAL STENOSIS

Atkins and Greening [63] divided patients with long-standing pulmonary symptoms but

nonspecific clinical findings into three groups on the basis of bronchoscopy. In the first group with emphysema there was diminution in the expulsive force of the cough, marked respiratory intrusion of the posterior bronchial walls, and thickening of the mucosa. In this type the secretion tended to be scanty when present and was whitish and mucoid in character. The second group of asthmatic patients presented a more forceful expulsive cough, extremely viscid secretion, and expiratory intrusion of the posterior bronchial walls with a pale mucous membrane. The third group revealed little disturbance in the expulsive force of the cough, consistent mucosal hyperemia, less secretion than one would expect to find from the physical findings, and no expiratory intrusion of the posterior wall. The patients with bronchial attenuations had anatomic narrowing of the bronchi shortly after their emergence from the main bronchial trunks, and wide spacing of these bronchi in the pulmonary pattern. There was also a physiologic alteration in the tracheobronchial tree, manifested by variations in the size of the lumen in different pulmonary segments. It was not apparent whether this physiologic alteration in the bronchus was an indication of an anatomical abnormality or a purely physiologic aberration. The attenuation of the bronchi that was invariably present in asthma seemed to be an essential component of emphysema, and was observed in apparently normal segments of the lung in patients with bronchiectasis, tuberculosis, and chronic lung abscess. Early in asthma and emphysema the attenuations seemed to be reversible, but when long continued, they appear to be irreversible.

Holinger [64] discussed bronchial obstruction as one of the fundamental causes of bronchopulmonary disease. While it may be produced by either endobronchial or extrabronchial lesions, the effect is dependent upon the degree of obstruction, apparent as a wheeze, obstructive emphysema, or atelectasis.

FOREIGN BODIES IN THE AIRWAY

Asherson [65] called attention to the rapidity of death following blockage of the glottis or trachea by a diverted swallowed bolus or foreign body. In these emergencies only prompt tracheotomy will prevent the dire result. If a main bronchus becomes blocked, death is inevitable, although delayed, unless the intruder is removed by endoscopic procedures.

Jackson [66] pointed out that a foreign body should be considered in every case of unexplained atelectasis or obstructive emphysema or whenever a laryngotracheobronchitis is present. In the roentgen study of a suspected respiratory foreign body, posteroanterior views of the neck and chest in inspiration and in expiration, lordotic and lateral views of the neck and chest, and fluoroscopy with a barium swallow should be employed. In spite of these, a single negative roentgenological investigation does not exclude the possibility of a foreign body, and the decision whether or not to perform an endoscopy must be made on the entire clinical picture.

Miller [67] reported that stereoscopic fluoroscopic guidance had made possible safe, easy removal of radiopaque foreign bodies from the bronchi when visualization was impossible with an ordinary bronchoscope. A total of 13 procedures with stereofluoroscopic guidance was performed on eight patients, two of whom were adults. The removal of the foreign bodies was successful in all the patients, with the exception of one straight pin, which had worked itself into the peripheral lung parenchyma of the right lower lobe, so that it was protruding onto the diaphragmatic surface when the foreign body was removed by thoracotomy. The only complication in the 13 procedures was a subcutaneous emphysema in one patient, which promptly cleared in four days. The majority of the successful removals were accomplished in from 30 seconds to four and one-half minutes after fluoroscopic guidance. In the unsuccessful attempts, bronchoscopic manipulation was never continued longer than 30 minutes. The three-dimensional visualization of the foreign bodies in relation to the bronchoscopic instruments allowed the fluoroscopist to determine at once whether or not the forceps were in the correct bronchus and in the

plane of the foreign body. This proved to be a decided advantage when compared with the use of a biplane fluoroscope in cutting down the length of time that the bronchoscope remained in place, as well as in reducing the total exposure of all concerned to radiation. It is necessary that the fluoroscopist have stereoscopic vision. It has been found that another bronchoscopist can sometimes better direct the operator, as his instructions are interpreted easier. The stereofluoroscope has also given excellent images of substances sometimes difficult to visualize with any fluoroscope, such as tiny bits of glass and a splinter of chicken bone. Aside from its use in foreign-body removal, it was suggested that three-dimensional fluoroscopy may be helpful in many other fields.

Five cases of grasses and cedar twigs as foreign bodies in the bronchi were reported by Mahoney.[68] Two of the foreign bodies were expelled by coughing, and three were removed surgically. None were visualized or removed bronchoscopically. The foreign bodies remained in the bronchi from three months to 14 years, and apparently this interval was so long that the foreign bodies had worked their way below the level of bronchoscopic visibility.

Black and associates[69] reported a case of a foreign body (pistachio shell) in the bronchial tree of a 9-year-old which simulated bronchial asthma by the persistence of a bilateral wheeze for more than a year. The correct diagnosis was made only after the patient coughed up the shell and the wheezing disappeared.

An unusual case of foreign body in a bronchus was reported by Fox and Vinson.[70] A straight pin that had been stuck through a pussy-willow bud was aspirated and lodged in the right lower lobe bronchus, producing a triangular area of atelectasis. The accident occurred when the patient was blowing pins inserted through pussy-willow buds through a bean shooter. Recovery was uneventful following extraction of the foreign body.

Writing from South Africa, Adler and Fuller[71] considered foreign bodies in the larynx to be in the province of the otorhinolaryngologist but that those in the tracheobronchial tree should be handled by the thoracic surgeons, who apparently perform most of the routine endoscopic procedures in that country. Of the 100 cases reviewed, 61 were treated by ear, nose, and throat surgeons and 39 by thoracic surgeons. For the 10 years prior to this report the mortality rate was progressively reduced from 25% to 2.1%. The following factors were considered responsible for the decline: adequate anesthesia, adequate instruments, use of the smallest bronchoscope compatible with the size of the patient, drugs (antibiotics, antihistamines, aminophylline), and increased endoscopic removal by thoracic surgeons.

BRONCHIAL ASTHMA

Mears and his associates[72] recognized the frequency of benign nontuberculous bronchostenosis as a complication of either intrinsic or extrinsic asthma. In a review of 1034 consecutive asthmatic patients who underwent bronchoscopic examination, 327 of these were found to have stenosis of one or more bronchi. The commonest indication for bronchoscopic examination in patients with asthma is the need of confirming or excluding the diagnosis of bronchostenosis. When the history and the results of physical and roentgenologic examination suggest the possibility of a complicating bronchostenosis, the patient should have the benefit of bronchoscopy. Bronchoscopic examination in the asthmatic person cannot be performed without some element of risk. Two of the 1034 patients in this study died after bronchoscopy. One died immediately after the procedure and the other a few hours later. Treatment of bronchostenosis consisted of dilatation of the stenosed bronchus and aspiration of retained secretions. Of the patients studied, 60.5% were immediately improved after dilatation of the stenosed bronchus and 63.6% experienced some improvement during the next several months. The asthmatic status remained improved in 60.5% of the patients studied.

Davison[73] pointed out that asthma which begins after the age of 40 is usually due to

an infectious bronchitis. Adequate management of patients having bacterial allergy includes elimination of all foci of infection. High eosinophile counts were found in the blood and bronchial exudate of patients with infectious asthma. Intramuscular penicillin was effective in treatment, provided large doses were used and the organisms were moderately sensitive. The use of autogenous vaccines was also effective, and cortisone was used as an adjunct for temporary relief. Coexisting sinus infection usually required surgical treatment. Bronchoscopic aspiration was useful in removing thick exudate and obtaining reliable specimens for sensitivity cultures and autogenous vaccines. Of the 50 patients in the series, 30 had bronchoscopic aspirations, some of whom had 6 to 10 bronchoscopies for symptomatic relief.

CHRONIC TRACHEOBRONCHITIS

The behavior of mucous glands situated in the bronchial walls and found in cases of chronic bronchitis or bronchial inflammation associated with bronchiectasis was studied by Duprez and Manpuy.[74] On bronchoscopy a certain number of these patients who had long-standing fibrous tuberculosis or chronic bronchitis showed a bronchial mucosa which appeared nacreous and atrophic. Long parallel ridges were observed to run from the larynx into the lobar bronchi. Careful study of the larger bronchi with a telescope in these patients revealed a few small round apertures leading to narrow ducts in the bronchial wall. They were mostly located in the neighborhood of the bronchial bifurcations. These openings represented mucous gland ducts. In edematous mucous membrane or sometimes in the normal mucous membrane these ducts were hidden by the turgescence of the cells and by the protective mucous layer which covered them. It was thought that chronic bronchitis led to the cystic degeneration of some of the mucous glands.

BRONCHIECTASIS

In a study of 60 cases of pneumonia, Bachman and his associates [75] performed bronchoscopic studies on 11 patients with bronchial abnormalities, as shown by bronchograms. Hyperemia of the mucosa in the branch bronchi leading to the area of pneumonia was found in every case. In 10 patients there was edema of the mucosa, in 7 patients a thick mucopurulent exudate was noted in the lumen, and in 2 patients a dry membranous exudate was present. When these patients were submitted to serial bronchoscopic examinations the mucosa returned to normal in all except one case, in which the inflammation, edema, and exudate persisted.

TRACHEOBRONCHIAL TUBERCULOSIS

In discussing the relationship of the bronchus to pulmonary tuberculosis, Young [76] pointed out the pitfalls in the diagnosis of bronchial disease by bronchoscopy. The only changes seen at bronchoscopy under favorable conditions were alterations in the mucous membrane, dilatation of the bronchi, and narrowing of the lumen. The fallacious character of the bronchoscopic report was shown by the author's findings in 80 cases of resection that were reported as normal bronchoscopically, for the proportion that exhibited evidence of gross bronchial stenosis on microscopic examination was over a half. It was not thought advisable to bronchoscope every patient with tuberculosis, but the indications were listed under two general headings. The clinical indications were hemoptysis, spasmodic cough, positive sputum without demonstrable cavities, wheeze, persistent pleural effusion, and the onset of considerable fluid in an artificial pneumothorax. The roentgenological indications were lobar or segmental atelectasis, abnormally small lobe without obvious atelectasis, sudden consolidation of a lobe under collapse, spread of disease from an apparently controlled lesion, and blocked or ballooned cavity.

Olson and his co-workers [77] studied 602 surgical specimens resected from patients with pulmonary tuberculosis, with particular reference to their bronchial pathology. In only 10% of the specimens were the bronchi normal. The incidence of the different types of bronchial involvement was as follows: chronic bronchitis, 29%; tuberculous bron-

chitis, 20%; bronchiectasis without endobronchial tuberculosis, 21%; bronchiectasis with endobronchial tuberculosis, 20%. There was a marked discrepancy between the bronchoscopic findings and the histopathologic specimens examined. Thirty-seven per cent of the specimens from patients who had normal bronchoscopic examinations actually showed endobronchial lesions. In some instances these lesions were in the submucosa of the main stem bronchi and should have been observed easily at bronchoscopy. There was no important statistical correlation between the bronchoscopic findings and the presence or absence of bronchiectasis. However, when bronchoscopic abnormalities were present, there was a tendency for the percentage of both bronchiectasis and endobronchial tuberculous lesions to increase.

In a study of 40 patients with primary pulmonary tuberculosis, 32 of the 35 patients who were examined bronchoscopically by Williams and Anderson [78] during an early stage of the disease had bronchial lesions. Thirty-two of the 40 patients developed permanent bronchiectasis and 10 permanent bronchostenosis. Thirty-one of the group of 35 patients had an obstructing lesion of the bronchus seen by bronchoscopy. The bronchial lesions seen on bronchoscopic examination were of three main types: First, 12 patients showed local bulging of one or both sides of the bronchial wall, reducing the lumen to a slit or complete occlusion. The mucosa in the bulging area was sometimes normal in appearance but more often red, congested, edematous, and covered with mucopurulent secretion. Second, in 10 patients the bronchial mucosa was red and swollen, with several submucosal yellowish or reddish areas of granulating tissue protruding into the lumen. In eight patients this granulating mass could be partially removed by aspiration. Third, in nine patients pale, watery-looking granulations partially or completely occluding the bronchial lumen were found. This granulation tissue was usually nonspecific chronic inflammatory tissue. In two patients thick tuberculous pus could be aspirated distally from the bronchus, which was almost completely occluded by granulation tissue. The bronchus most commonly involved was the right. Correlation of the bronchoscopic lesions with the segment or lobe of the lung involved showed that in 32 of the 35 patients the lung lesion seen roentgenographically was primarily due to bronchial obstruction from bulging of the wall, from a tuberculoma, or from granulation tissue. In the remaining three patients no definite bronchial lesion other than reddening and swelling of the bronchial orifice was observed. In 22 of 32 patients who had a demonstrable bronchial lesion complete resolution occurred, leaving a normal bronchial lumen, so that it was impossible to detect the site of the previous lesion on bronchoscopic examination. In the remaining 10 patients the tuberculous process caused sufficient damage to leave a permanent narrowing or stricture of the bronchus. The only means of knowing that the primary infection was progressing and causing a bronchial lesion, with subsequent bronchiectasis, was by serial roentgenological and bronchoscopic examinations. There was no way of distinguishing by clinical and roentgenological evidence the patients who were likely to receive benefit from bronchoscopic aspiration. Bronchoscopic aspiration of granulation tissue, tuberculoma, or caseous material from the gland was carried out in 19 patients. Although this procedure was safe and did not disturb the patient, its efficacy seemed limited, for reaeration of a collapsed lobe occurred in only four patients. It was thought that bronchostenosis and bronchiectasis do not require surgical resection unless chronic secondary infection develops.

Fischer [79] observed that perforation of the bronchial wall by lymph nodes occurs in areas that are most closely surrounded by lymph nodes, and frequently is seen in patients with late primary tuberculous infection. Perforating lymph nodes are characterized by discharge of caseous lymphatic tissue or pus from a mucosal lesion, ulceration, or fistula-like openings. Bronchial tuberculous involvement adjacent to the hilus was never considered to be primary, but linked to specific lymphadenitis. Because of the

presence of lymphadenobronchogenic lesions the development of tuberculous stenosis is not rare.

Dufourt and his co-workers [80] pointed out that bronchial perforations of lymph nodes that coincide with the onset of chronic tuberculosis are exceptional. At a later stage the lesions appear in a lymph node and may lead to fistulas, especially after the age of 50. These fistulas are usually bronchial or esophagobronchial and oft-times bipolar or multipolar.

Himalstein [81] pointed out that one should not be lulled into minimizing endobronchial disease because of the introduction of specific drug therapy. Stenosis can develop in the face of streptomycin therapy. Even when there is no presumptive evidence of obstruction, a lesion may be visualized, and vice versa. Any regression or failure to improve clinically or by x-ray would seem to be an indication for bronchoscopy irrespective of the other usual indications. Preliminary bronchoscopic examination should be done before any surgery or the institution of collapse therapy. The accepted clinical and roentgen indications are unilateral wheeze, unexplained positive sputum, spread, dyspnea or fever, atelectasis, obstructive pneumonitis, tension cavity, and obstructive emphysema.

The bronchoscopic aspect of tuberculous tracheobronchitis with the change brought about by the use of antibiotics and antimicrobial agents in the treatment of tuberculosis was discussed by O'Keefe.[82] The development of these more effective therapeutic agents has not detracted from the value of nor eliminated bronchoscopy in the management of these patients. By the use of bronchoscopy, the complications of bronchial obstruction may be averted or other bronchopulmonary disease coexisting with tuberculosis may be identified. Some persons have persistently harbored endobronchial lesions unresponsive to all forms of antimicrobial therapy, but it is hoped that control of these resistant strains will eventually occur with the development of more effective antimicrobial agents. There was also noted increasing numbers of tuberculous patients who presented signs of bronchial obstruction due to the compressive effects of extrabronchial tuberculous lymph nodes. Since these complications produce obstruction which responds poorly to medical therapy in many instances, some form of surgical excision is necessary.

A differential diagnostic roentgen sign between tuberculosis and carcinoma was described by Poppel and his co-workers.[83] Inflammatory disease of the upper lobes of the lungs (usually tuberculous) was found to be associated with tracheal buckling or angulation, while in unilateral upper lobe carcinoma no change in the trachea was found. In a series of 115 cases of moderately or far advanced pulmonary tuberculosis with predominant unilateral upper lobe involvement, 54.8% demonstrated buckling of the trachea toward the involved side. This was explained by an advanced unilateral fibrosis which produced tracheal angulation. In a review of 263 cases of bronchogenic carcinoma of an upper lobe, only 7 demonstrated buckling of the trachea, 2 of which were also victims of concomitant tuberculosis.

CYSTIC FIBROSIS OF THE PANCREAS

In a review of 211 patients with cystic fibrosis of the pancreas, di Sant' Agnese [84] found lobar atelectasis with obstructive emphysema in approximately 10%. It indicated severe respiratory disease, manifested by cough, cyanosis, and respiratory distress. Bronchial obstruction was due to failure to remove secretions initially, followed by secondary infection. The lobar atelectasis associated with fibrocystic disease of the pancreas was rapidly fatal in many instances unless checked by the use of antibiotics. Bronchoscopy and bronchial aspiration through a tracheotomy tube were usually not effective, and the best weapons were early diagnosis and early antibiotic therapy. If the patient survives the first episode, the same cycle may return again with a subsequent respiratory infection. Although respiratory involvement is an almost constant accompaniment of the pancreatic lesions in

cystic fibrosis of the pancreas, their interdependence is still unexplained.

PULMONARY ABSCESS

A series of 70 cases of neoplastic lung abscess, which represented 3.6% of the cases of bronchial carcinoma, was studied by Strange and Simpson.[85] The bronchoscopic findings were divided into two types. Type 1 included the cases in which the carcinoma involved a major bronchus with distal abscesses. In Type 2 the findings were essentially negative, and in these cases the abscess appeared to arise from necrosis in the center of the tumor. In 58 of the 70 cases the findings at bronchoscopy afforded proof of the neoplastic nature of the abscess. Histologic evidence was not obtained in all of these, but visual evidence of cancer invasion was accepted. In 12 cases there was no conclusive proof, but the combination of clinical, roentgenological, and bronchoscopic findings was considered sufficient to warrant a diagnosis of carcinoma. Lung abscess occurring in association with bronchial carcinoma often presents difficulties in diagnosis, and frequently these cases are wrongly diagnosed as simple abscesses or tuberculous cavities. The prognosis in this type of case is extremely poor.

PULMONARY BLASTOMYCOSIS

During an active phase of pulmonary blastomycosis Weisel and Landis[86] found endobronchial lesions on bronchoscopic examination of seven patients, and in two patients the findings were confirmed pathologically by surgically removed specimens. The commonest bronchoscopic findings were superficial mucosal ulceration and the presence of a rather characteristic type of retained secretion in the involved bronchial segments. The secretion presented a thick tenacious light brown appearance, with a shiny surface. The bronchoscopic visual findings were helpful in the diagnosis, and the material obtained bronchoscopically proved to be beneficial in the bacteriological identification of the infecting fungus.

BRONCHIAL AMYLOID DISEASE

Schmidt and his associates[87] reported three cases of amyloid tumor of the lower part of the respiratory tract and mediastinum. Since bronchogenic carcinoma could not be entirely excluded in two patients, pneumonectomy was performed. The third patient was treated by bronchoscopic removal of a part of the tumor. Two of the patients received roentgen treatment in the region of the tumor, but the effect of roentgen therapy was questionable. This type of disease runs a benign course unless the tumor infiltrates and causes bronchial obstruction. When this occurs, relief must be secured either by resection or by improving the airway by bronchoscopic removal of a portion of the tumor. All the patients remained clinically well over a five-year period, and any therapy directed toward the relief of symptoms should be as conservative as possible.

Whitwell[88] performed a bronchoscopy on a middle-aged man because of a recent hemoptysis and found a peculiar polypoid thickening of the mucosa of the lower trachea and main bronchi, with an isolated tumor in the right lower lobe bronchus. Histologic examination of the bronchial lesions revealed characteristic amyloid deposits, although there was no generalized amyloidosis. The bronchial lesions of amyloid disease are remarkably uniform, so that a correct diagnosis should be made by the bronchoscopic and histologic appearance in the majority of cases.

TREATMENT OF CHRONIC BRONCHOPULMONARY DISEASE

The intrabronchial use of streptokinase and streptodornase was found to be a useful adjunct in the treatment of slowly resolving pneumonia by Miller and associates.[89] Bronchoscopic examination should always precede the use of this medication because a bronchogenic carcinoma which could cause pulmonary infiltration and atelectasis might be present. The mechanical removal of purulent exudate by aspiration at the time of bronchoscopy is also a definite help in the treatment of atelectasis and also might be employed

before the use of these medications. Following bronchoscopy, streptokinase, 150,000 units, and streptodornase, 50,000 units, dissolved in 10 cc. of isotonic sodium chloride solution was introduced into the involved bronchus. After this, the patient was instructed to lie in a position so that the involved lobe would be lowermost and to remain in this position for at least four hours. If there is not a great deal of secretion, the medication can be repeated by intratracheal catheter every other day. The intrabronchial instillation of streptokinase and streptodornase is contraindicated in the presence of active pulmonary tuberculosis to avoid possible bronchogenic spread of the disease. It was also suggested that these agents might prove useful in the presence of undiagnosed carcinoma with a negative bronchoscopy to produce loosening of plugs of cellular debris from terminal bronchioles and allow aspiration of large quantities of serum and sputum for direct examination for tumor cells.

Flippen and his co-workers [90] studied the effects of diethylaminoethyl ester hydriodide of penicillin G (Neo-Penil) in certain body tissues and organs and concurred in the finding that Neo-Penil has a far greater affinity for the lungs than have the other penicillin preparations. Since unusually high tissue concentrations occur in the absence of high blood levels, it was felt that the tissue levels are due to the pharmacologic property of the drug, and not merely to a high blood-tissue effusion level. It was also shown that Neo-Penil is a repository penicillin salt but to a lesser degree than is penicillin G procaine. In a comparison of the effectiveness of Neo-Penil and penicillin G procaine in bacterial pneumonia, 114 cases were studied in which 55 were treated with Neo-Penil and 59 were treated with penicillin G procaine. No significant difference between the two forms of penicillin was noted in their ability to reduce fever. Both forms appeared to be equally successful as far as the end-results of therapy were concerned.

Clinical studies in biological assays of a new penicillin preparation (diethylaminoethyl ester hydriodide of penicillin G) were carried out in patients with pulmonary diseases by Dulfano and Segal.[91] The clinical results were encouraging, as evidenced in the relief of cough, the decrease and change in character of the expectoration, and the control of temperature. Penicillin sputum peak levels were consistently much higher than those obtained in the blood serum. The appearance at the end of treatment of new bacterial flora, though frequent, did not alter the beneficial clinical results. Neo-Penil appeared to be an effective penicillin preparation for pulmonary diseases whenever a high or local concentration of the drug in the diseased lung was desired.

Clinical and bacteriological observations on the use of Neo-Penil in patients with chronic bronchitis, bronchiectasis, and pneumonitis were made by Barach and his associates.[92] Of 100 courses of treatment, an excellent result was obtained in 55, moderate improvement in 27, and little or no benefit in 18. The penicillin concentration of the sputum after intramuscular injection of 500,000 to a 1,000,000 units of Neo-Penil varied between 0.1 and 1.5 units per cubic centimeter in 48 of 68 cases. In 19 instances the penicillin level in the sputum after a million units was between 0.2 and 0.48 units per cubic centimeter. The side-effects of the drug have not been of such severity and frequency as to limit its employment, although allergic reactions to penicillin and the consequences of iodine sensitivity were encountered. This study suggests that the use of Neo-Penil has an effective action in the control of infections due to Gram-positive organisms.

BRONCHIAL ADENOMA

Touroff and Seley [98] presented 14 unusual cases of adenoma of the large bronchi in which the tumor was visible both bronchoscopically and roentgenographically. Since on endoscopic examination it is impossible to determine whether an adenoma has extended outside the lumen, the authors advocate further investigation by means of sectional roentgenography in every case in which the diagnosis has been established by bronchoscopy. This further roentgenological study

is valuable to determine the extent of the lesion and serve as a guide to the type of therapy.

A case of bronchial adenoma in a 4-year-old white boy was reported by Berger and his co-workers.[94] Bronchoscopy performed because of left lower lobe atelectasis revealed an obstructing lesion in the left main bronchus, histologic section of which was reported as bronchial adenoma. Frequent bronchoscopic treatment with removal of portions of the growth was done, but gradual narrowing and eventual occlusion of the left bronchus occurred, and pneumonectomy was performed. On histologic study of the specimen it was found that not only had there been extension into the peribronchial area but replacement of lymphoid structure by adenomatous cells had occurred within a hilar lymph node.

A case of bronchial adenoma removed bronchoscopically was reported by Karatay.[95] At bronchoscopy a smooth-surface tumor was noted at the junction of the right main bronchus with the lower lateral subdivision of the lower lobe bronchus, and after the histologic diagnosis was confirmed, the tumor was removed by cutting forceps. Since the growth was attached by a rather broad base, complete removal was not accomplished at the first sitting. Two months later the remnant of the base was removed and thorough cauterization performed.

LIPOMA OF BRONCHUS

Smart[96] reported two cases of lipomata within the bronchial tree, both of which had atelectasis as the chief finding. In one case the tumor was lobulated and attached to the right lateral wall of the trachea by a ½ in. (1 cm.) pedicle. The tumor was removed piecemeal with biopsy forceps on a subsequent bronchoscopy. In the other case the tumor was also mobile and pedunculated, but attached to the left main bronchus. The bulk of the lipoma was removed at bronchoscopy, but bleeding prevented removal of the base, and the lower lobe remained collapsed. The patient felt well, and further bronchoscopic removal was not attempted.

PULMONARY LEIOMYOSARCOMA

A case of primary pulmonary leiomyosarcoma in a 7-year-old child was reported by Killingsworth and his co-workers.[97] On bronchoscopy a smooth, reddish tumor was visualized filling the lumen of the left main bronchus at the level of the upper-lobe orifice. On four occasions repeated biopsy specimens were taken and reported as nonspecific granulomatous inflammation, and the diagnosis was made on section of the tumor at exploratory thoracotomy.

CYTOLOGY

Jennings and Shaw[98] reported a series of 395 cases of bronchogenic carcinoma in which cytological sputum examinations were positive in 60.7%. There were six false positives (2.5%) in 563 nonmalignant cases examined. The bronchial biopsy was positive in 39.2% of the cytologically positive group and in 41.3% of the cytologically negative group.

BRONCHOGENIC CARCINOMA

Ochsner[99] discussed the role of the bronchoscopist in the early diagnosis of bronchogenic carcinoma. The distinct parallelism between the use of cigarettes and the instance of bronchogenic cancer was noted. Bronchogenic carcinoma was considered a disease primarily of the upper lobes, and for this reason the lesion may not be visible on bronchoscopy. In the author's series of cases the main-stem bronchus was involved in only 4%, the lobe bronchus in 60%, and the peripheral bronchus in 36%. While cough is the principle manifestation, hemoptysis, thoracic discomfort, and wheezing are other symptoms which need prompt investigation. Recurrent nerve or phrenic nerve involvement indicates extension of the neoplastic process beyond the lung, but Ochsner believes that it does not always mean nonresectability. Bronchoscopy is of importance not only because the lesion frequently can be visualized and biopsied but also because bronchial secretions can be obtained and the condition of the trachea and main-stem bronchi determined. Since over half of the tumors were located in the upper lobes and about a

third in the periphery, a positive diagnosis on bronchoscopy was made in only 37% of the cases. The method of diagnosis which gave the highest percentage of positives was cytologic examination of the bronchial secretions with a 68% positive diagnosis. The desirability of making the diagnosis early is evident when it is realized that the five-year salvage was only 7.2% in those cases in which a palliative resection was possible, while in the cases in which the lesion was apparently limited to the lung, it was 36.2%.

In discussing the endoscopic diagnosis of early bronchial carcinoma, Eeman [100] emphasized the value of a positive histologic diagnosis obtained by either tissue biopsy or cytologic examination. In addition, bronchoscopic visualization of the entire tracheobronchial tree often provides additional information for the surgeon.

In a study of a thousand cases of proved bronchogenic carcinoma, Moersch and McDonald [101] found that bronchoscopy was a more effective diagnostic procedure in cases in which the tumor arose from the central portion of the lung, that is, in cases of small-cell carcinoma and in cases of squamous-cell carcinoma. Likewise, cytologic examination of the sputum or bronchial secretions was more effective in the cases of small-cell carcinoma and least effective in the cases of adenocarcinoma.

SCLERODERMA AND CARCINOMA

An association between scleroderma and bronchiolar carcinoma was found in three cases by Zatuchni and associates.[102] The pulmonary symptoms simulated bronchiectasis, tuberculosis, and pneumonitis, respectively. While diffuse interstitial pulmonary fibrosis was present, there was also terminal bronchiolar carcinoma in each instance, with distant metastasis occurring in two of the three persons. The bronchoscopic findings consisted of thickening and edema of the mucosa with a suppurative exudate.

DYSPHAGIA

Bauer [103] emphasized that dysphagia due to cervical spondylosis is far from rare, and lists six instances of it in one year. It seems likely that many cases are unrecognized because the relationship of the spondylosis to the dysphagia is not appreciated. Spondylosis may be responsible for stricture formation and for recurrent laryngeal nerve paralysis. Other possible causes of dysphagia, especially carcinoma, which may coexist, must be excluded by means of esophagoscopy. Esophagoscopy alone by its dilatory effect has some therapeutic value in relieving symptoms.

Ingelfinger and Kramer [104] reported six cases of dysphagia caused by an excessive active constriction ring that produced intermittent occlusion of the esophagus and stomach and did not produce dysphagia unless it trapped solid food, thereby occluding the lumen. On esophagoscopic examination no lesion was identified, and the esophagoscope passed into the stomach without difficulty. One of the patients was benefited by surgical removal, another by dilatation of the lower esophagus, and the other four carried on satisfactorily by chewing carefully and following dietary measures. The authors felt that if the claim of several anatomists was correct that a physiological sphincter exists in the esophagus 1 to 2 cm. above the diaphragmatic hiatus, the constriction ring may be identified tentatively as an overactive inferior esophageal sphincter.

Madsen [105] reviewed 108 benign disorders of the esophagus found in patients referred for observation for esophageal cancer. In 68 cases of dysphagia in older persons cancer was suspected, and in 38 cases the roentgen examination before admission led to the suspicion of cancer of the esophagus. In the benign cases the results of repeated roentgen examinations, with special attention to the suspected part, ruled out esophageal cancer, but the surest information was obtained by esophagoscopy, which is always indicated when the roentgen examination shows an esophagitis. On account of the vague initial symptoms in cancer of the esophagus, the author recommended roentgen examination even in cases in which there was no marked dysphagia.

ESOPHAGEAL CAST

A case of simple esophageal cast was reported by Baird and Cohen.[106] After eating, a 35-year-old woman felt a heaviness behind the upper sternum and vomited bright red blood together with a whitish tube. She replaced the tube by pushing it back into her throat and swallowing. On subsequent vomiting the tube became detached from the throat. Histologic study revealed an esophageal cast with a greatly thickened epithelial layer. Esophagoscopy 16 days after extrusion of the cast revealed a pale atrophic mucous membrane until the esophagoscope had been passed for 25 cm., beyond which the mucosa was hyperemic and bled easily when touched. The etiology of this extremely rare condition is unknown, but the authors suggested that the cast is formed in the following manner: A small split is produced, possibly by trauma, in hyperplastic esophageal epithelium, and the rise in intraesophageal pressure produced by swallowing causes the split to progressively enlarge. As the dissection proceeds, new epithelium grows from the basal layer, further separating the cast, which becomes completely detached on vomiting.

ACHALASIA OF CRICOPHARYNGEAL SPHINCTER

Any lesion, whether muscular, neuromuscular, or neurogenic, that interferes with the advance of the peristaltic wave down the pharynx ahead of a swallowed bolus will produce the syndrome of achalasia of the cricopharyngeus muscle, described by Asherson.[107] The common causes are paralysis of the pharyngeal plexus after anterior poliomyelitis, unilateral or bilateral recurrent laryngeal nerve paralysis, or after pharyngectomy. The usual symptom is mild dysphagia, which is more marked for fluids than solids in the early stage. The pharyngogram was considered characteristic, whereas esophagoscopic study generally gave negative results.

PHARYNGOESOPHAGEAL DIVERTICULUM

Endoscopic treatment of hypopharyngeal diverticula was performed by Larsen [108] in 10 cases by electrocoagulation, cutting the wall between the sac and the esophagus. The cricopharyngeal muscle invariably was hypertrophic, measuring 7 to 8 mm. in thickness in some instances. Despite partial persistence of the pouch after this procedure, the symptoms disappeared. Follow-up study varying from two to six years revealed free passage of the contrast medium with rapid emptying of the sac on roentgen examination, and free passage of the esophagoscope into the esophagus, with no irritation of the mucous membrane visible on direct examination.

FOREIGN BODIES IN THE FOOD PASSAGES

Harris [109] described a method of extracting a large irregular-shaped bone in the esophagus. With the use of an oval lumen esophagoscope the foreign body was grasped with cutting forceps on one of the pointed edges, and the scope was advanced down over the foreign body. Since this fixed the foreign body so that little rotation resulted, small pieces of bone were broken off by twisting the forceps and holding the esophagoscope rigid. After several pieces of bone were broken off, the foreign body was extracted without difficulty.

Waters [110] reviewed atypical cases of foreign bodies in the esophagus and reported a case of embedded calcified foreign body (peach stone) in the thoracic esophagus. This unusual case was found in a 64-year-old white woman, who gave a history of having swallowed a peach stone at the age of 6 years. At the age of 4 she swallowed a small quantity of lye, and the subsequent difficulty in swallowing was attributed to the lye, rather than to the peach stone. Recurrent dysphagia, choking sensation, and inability to retain nourishment occurred for the next 58 years. After a barium swallowing function revealed an obstruction at the level of the seventh or eighth thoracic vertebra, esophagoscopic examination revealed the presence of the foreign body, which was removed. No explanation could be given as to why the foreign body should accumulate an outer coating of calcium despite the long period of sojourn in the esophagus. After removal of the calcific deposit, there was no evidence of decomposi-

tion of the peach stone and the same irregularities and shape presented themselves as in a fresh specimen.

A case of esophageal obstruction due to the ingestion of a methylcellulose tablet used for weight reducing was reported by Hedayaty and Shuman.[111] The obstruction was entirely a mechanical one, with the water-absorbing compound producing sufficient bulk to completely block the esophagus.

Another case report of extraction of a ferromagnetic foreign body from the gastrointestinal tract with the Alnico magnet was added to the literature by Bancks and his co-workers.[112] The foreign body (nail) was readily removed from the stomach under fluoroscopic guidance.

ESOPHAGEAL ULCER

A case of perforation of the aorta by a benign esophageal ulcer, with fatal hemorrhage, was reported by Nardi.[113] The inflammatory changes resulted from the contiguity of the esophageal ulcer and the aorta. The pressure from a hiatal hernia may have caused such a contact and provided the primary factor in the fatal perforation.

PLUMMER-VINSON SYNDROME

Bingham and Logan [114] observed 16 cases of Plummer-Vinson syndrome. The dysphagia was due to organic stenosis in the upper esophagus at or just below the cricopharyngeus muscle. At times the lumen is only a few millimeters in diameter or may appear in the middle of a diaphragm-like obstruction. The stenosis may extend for varying distances along the esophagus. When one is able to introduce the esophagoscope through the cricopharyngeus, oft-times a web of mucosa occluding perhaps two-thirds of the lumen can be observed. At times two webs may be present. The more likely cause of the dysphagia is an eccentric opening in the diaphragm-like obstruction, rather than web formation. No ulceration or esophagitis was observed in the cases reported. Because the site of the narrowing is at or just beyond the cricopharyngeus, the dysphagia consists of the patient's not being able to move food from the hypopharynx into the esophagus, thus differentiating this dysphagia from that of lower esophageal disease. Since the food does not enter the esophagus, there is no retention of food or fluid, or regurgitation. In the treatment the only successful management is dilatation of the stenosis. Before the esophagoscope can be passed through the stenosis, the stricture almost always has to be dilated first with bougies. This is also necessary so that the remainder of the esophagus can be examined to rule out carcinoma. Although anemia accompanies this condition, no amount of iron will correct the dysphagia, and mechanical dilatation is necessary for this.

ACUTE ESOPHAGEAL BURNS

Holinger and his associates [115] found acid burns of the esophagus much less common than alkaline caustic burns in the ratio of 1:20. Acid burns were more severe, causing extensive erosion and necrosis of the esophageal and gastric walls, often complicated by the expulsion of a mold of the entire esophagus. A fatal case of concentrated nitric acid ingestion was reported in which the walls of the esophagus and stomach were perforated by the acid, and in which a mold consisting of the esophageal wall was extruded on the ninth day. An experimental study of the effects of concentrated nitric acid on the esophageal wall revealed almost complete necrosis of the mucosa, submucosa, and mucosal glands. In several areas there were abscesses, which in two instances were found to have penetrated the muscle coat. Partial necrosis of the muscle wall, with marked inflammatory reaction, was observed in the esophagus along its entire course. Jejunostomy, rather than gastrostomy, was suggested in cases of acid burns, because a frequent complication is extensive damage of the mucosa of the stomach. In treatment early mercury-filled bougie dilatation was advocated except in cases of severe acid burns, in which it appears to be contraindicated.

ESOPHAGEAL STRICTURES

A series of 130 cases of lye burns of the esophagus were observed by Hung and asso-

ciates.[116] Of 41 patients with acute burns, 15 died immediately or within a few days after ingestion of a highly concentrated solution of a caustic. Those who survived did not have the benefit of further treatment, particularly of early dilatation to prevent stricture formation. Consequently, nearly half the patients with stenosis were not treated until several months after the ingestion of the caustic. This resulted in single or multiple strictures or atresia with secondary dilatation above the stenosis in many patients. The strictures occurred most frequently in the middle third of the esophagus, commonly at a point 25 cm. from the incisor teeth. Strictures in the lower and upper thirds of the esophagus occurred in the remaining one-fifth of the patients, despite unfavorable circumstances for treatment, improvement was obtained in 17 of 28 patients by repeated insertion of bougies under esophagoscopic visualization. In the successful cases a dilator was placed in the stenosed area for three or four hours at two- to three-day intervals, a larger dilator being used in one to three months. Only one patient required more than six months for the dilatations. The 10 patients listed as cured could swallow solid or semisolid food without discomfort, regained their body weight, and tolerated daily work well.

Burford and his co-workers [117] correlated the results of experimentally produced lye burns of the esophagus with the pathologic findings in a series of human cases. Experimentally it was found that reepithelization of the denuded areas was incomplete until the sixth week, and up to this time inflammation persisted and granulation tissue did not mature. Actual stricture formation was discernible after the second week and was definite before the end of the fourth week. Seventeen strictures of the esophagus were treated in humans by surgery, with satisfactory results. The authors do not believe that there is any justification at the present time for the Salzer method of treatment. It was felt that the marked inflammatory and necrotic change present during the first seven days after the burn condemned early dilatation. Not only was the procedure considered potentially hazardous, but insult was added to injury by increasing damage. Efforts during this period should be directed toward minimizing infection and hastening repair. This can best be achieved by giving the damaged esophagus absolute rest by the administration of adequate doses of antibiotics. If a stricture is going to develop, evidence will be present within two weeks. It was recommended that no esophagoscopic examination be performed until the fourth week and, if a definite stricture was present, cautious dilation should be done. If the stricture does not respond to a few judicious dilatations, surgical resection of the stricture was recommended. The authors considered all established strictures to be surgical problems.

Two cases of esophageal stricture caused by ingestion of sodium hydroxide (lye) which were treated by thoracotomy and endoscopy were reported by Barbosa and associates.[118] Using the technique of Barreto, they introduced one esophagoscope through the mouth and the other through a previously made gastrostomy. The esophagus was then exposed by thoracotomy and was made visible to the endoscopist by means of a mirror above the surgical field. The upper and lower portions of the esophagus were brought into the same axis, and the distal ends of the two esophagoscopes were approximated as closely as possible. A long cannula was introduced through the retrograde scope and advanced into the narrowed portion of the esophagus below the stricture. The surgeon pulled the esophagus over the cannula as far as possible. A long needle carrying threads was introduced through the cannula and pushed through the atresic portion of the esophagus into the upper esophagoscope. The threads were brought out through a nostril and the gastric stoma and were used to carry dilators. Functional results in the two cases reported were excellent.

Harvey and Negus [119] described a safe method of gradual dilatation for esophageal strictures using a hollow mole, which allows saliva and fluids to be swallowed during treatment. While this method is not particularly disturbing and may avert the need for

surgical reconstruction, both patience by the patient and the physician and repeated dilatations are required for successful treatment. A plastic bobbin with a rounded body and an elongated flexible neck was devised to act as a mole and burrow its way slowly through the stricture. An eyelet at the upper end enables the bobbin to be tied to a continuous thread, which passes lengthwise through the center. A constant pull is maintained by a strong elastic band applied to the string as it comes out of the gastrostomy opening, so that the mole gradually passes through the stricture. The average time for passage is four to five days, and larger sizes are used as the stricture dilates.

The effects of cortisone on acute lye corrosion of the esophagus was discussed by Smith and his co-workers.[120] Stricture following lye burn of the esophagus is the end-result of fibroplasia, which begins within three or four days of tissue injury. Since cortisone prevents fibroplasia, it might also be expected to inhibit stricture formation by preventing collagen. The use of cortisone if successful might relieve patients of repeated mechanical dilatation, which now requires years of treatment. As yet cortisone treatment of acute lye burns of the esophagus has not had a fair clinical trial, and a tentative but untried medical program for cortisone treatment to be begun immediately after injury was outlined. Cortisone therapy is potentially dangerous, and precautionary measures must be taken, including hospitalization, close supervision, frequent roentgenologic study, and liberal use of antibiotics.

Rosenberg and associates [121] demonstrated that cortisone is a potent inhibitor to scar tissue contracture in the rabbit esophagus following experimental lye burn. It was necessary to employ large doses to produce this effect, and such large doses of the hormone caused high morbidity and mortality due to intercurrent suppurative infections, mostly intrathoracic. The administration of penicillin concurrently with cortisone markedly decreased the incidence of infection and favorably influenced the mortality. Since spontaneous perforation of the ulcerated esophagus occurred in 5 of 44 rabbits under cortisone therapy, it would seem from these experimental observations that much more study is required before this potent drug can be safely directed to the therapy of acute lye burns of the human esophagus.

Bigelow [122] believed that the late development of carcinoma at the site of esophageal scarring resulting from a lye burn represented a relationship that was of more significance than mere coincidence, and reported a case that developed in a lye stricture of 40 years' duration.

A case of esophageal obstruction due to mediastinal paraffinoma was reported by Kergin.[123] Six years after paraffin oil was introduced into the extrapleural space as a fill for an extrapleural pneumothorax, the patient developed dysphagia due to a paraffinoma of the mediastinum, which invaded the esophagus and produced a stricture which proved refractory to dilatation, necessitating surgical treatment.

THORACIC STOMACH

Allison and Johnstone [124] presented a comprehensive review of the esophagus lined with gastric mucous membrane. In the seven patients presented in which the lower esophagus was lined by gastric mucous membrane, all had reflux esophagitis, and in four this had progressed to fibrous stenosis. One also had two gastric ulcers in that part of the esophagus lined by gastric mucous membrane, from one of which there had been profuse bleeding. One patient had a chronic gastric ulcer in that part of the esophagus lined by gastric mucous membrane, and this had not only caused stenosis but had penetrated the esophageal wall to produce perforation into the mediastinum. One patient developed a gastric carcinoma arising and confined to the abnormal segment. The commonest site of stricture was in the squamous part of the esophagus. A variable amount of the esophagus below the aortic arch may be lined by gastric mucosa of the cardiac type. Sliding hernia of the stomach into the mediastinum with incompetence of the cardia may cause reflux esophagitis, and by a process of

submucous fibrosis may lead to esophageal stenosis. Roentgenologic investigation alone is not enough to diagnose abnormality of gastric mucous membrane in the esophagus, since the mucosal pattern gives no clue to the change in the histology. It may be presumed to be present when there is a marked difference between the level of the mucosal change at esophagoscopy and the estimated level of the cardia from the roentgenogram. Gastric ulcers may occur in that portion of the stomach above the diaphragm, and if they do not cause stenosis, they may be missed by both the radiologist and the esophagoscopist. Severe bleeding is more likely to come from the gastric mucous membrane than from the esophageal membrane. Shallow ulcers and gastric folds can easily be missed at esophagoscopy. The authors advocated revision in the methods of roentgenologic investigation of the lower end of the esophagus. It was suggested that an ulcer rising in the gastric pouch be named Barrett's ulcer, since he first described the condition.

ESOPHAGEAL HIATAL HERNIA

Flood and his associates [125] demonstrated that hiatus hernias were frequently accompanied by ulcerative esophagitis. The esophagitis seen in association with hiatus hernia is usually located in that portion of the esophagus immediately above the cardia and appears during esophagoscopy as a shallow ulceration of the esophageal mucosa. Spasm or true organic stenosis of the lower esophagus may be associated with the ulceration, but these changes often have been unrecognized because of the infrequency with which esophagoscopic examination has been performed in patients with hiatus hernia. Esophageal reflux was demonstrated by roentgenologic or intubation techniques in more than half of the patients studied with hiatus hernia. Acid reflux was found in patients both with and without evidence of esophagitis. It was not possible to demonstrate esophageal reflux in a number of persons suffering from esophagitis. Further observations on the occurrence and the mechanism of the esophageal reflux are desirable in order to clarify problems of the pathogenesis of esophagitis.

The different grades of esophagitis in hiatus hernia were explained by Aylwin [126] on the combined basis of variations of the histologic structure and function in that part of the stomach which forms the hernia and vagal overactivity which accompanies severe damage. The origin of the activity might be constitutional, but it would seem more likely that severe esophagitis produces vagal irritation, which in turn is responsible for increased salivary, esophageal, and gastric secretions. The salivary and esophageal secretion is protective, but the gastric hypersecretion is not and continues even at night to form a vicious circle ending in a peptic stricture of the epithelium of the pouch. Observations through the esophagoscope were considered fundamental in determining reflux peptic esophagitis, which was the result of disturbed physiology in the esophagus.

After a clinical and roentgen study of gastroesophageal regurgitation, Werbeloff and Merskey [127] concluded that there was no correlation between epigastric or substernal pain related to posture and gastroesophageal reflux. This type of pain is a feature of hiatus hernia, which is often associated with regurgitation.

In discussing esophageal hiatal hernia, Shaiken [128] used esophagoscopy to determine the presence of a peptic ulcer or erosion in the esophagus or within the hernia in cases of hemorrhage and chronic blood loss. A biopsy obtained from the mucosa was used to determine if gastric tissue was actually present in the hernia and to establish a diagnosis of a congenital short esophagus.

Robb [129] called attention to the frequency with which malignant disease is found in association with hiatus hernia and thoracic stomach, and reported 3 such cases among some 70 patients with hiatus hernia that were treated surgically.

EPIPHRENIC ESOPHAGEAL DIVERTICULUM

Seven cases of epiphrenic esophageal diverticulum were reported by Putney and Clerf.[130] Histologic study of the walls of the

excised diverticula revealed the muscular coat to be thin and practically absent, but the sympathetic nerve ganglia were intact, without microscopic abnormality. There were no characteristic symptoms of this lesion. One case had an associated hiatal hernia, another was complicated by both a hiatal hernia and achalasia, and a third had coexisting traction and pharyngoesophageal pulsion diverticula. Although the diagnosis was made by roentgenologic study, esophagoscopy served to confirm the diagnosis and detect complicating lesions, at the same time providing additional information about the mucosal changes. Three patients were not operated upon, and all were able to perform their daily routine, one patient having a 17-year follow-up period. In the surgical treatment, excision of the sac without interference with the esophagogastric junction was preferred over resection of the lower esophagus and esophagogastrostomy because of the subsequent development of esophagitis and dilatation of the esophagus after the latter procedure.

Julian [131] reported a case of epiphrenic esophageal diverticulum which gave rise to pain resembling angina pectoris, with characteristic electrocardiographic abnormalities. While the electrocardiographic findings indicated evidence of coronary insufficiency before resection of the diverticulum, the tracings have been repeatedly normal afterward. Coronary vasoconstriction probably resulted indirectly from distention of the diverticulum, possibly from a vagal reflex.

ESOPHAGEAL ACHALASIA

The studies of Butin and associates [132] using a miniature electromagnetic transducer to record accurately esophageal pressures after swallowing confirmed the present concept that the entire esophagus is involved in the pathologic physiology of cardiospasm. The changes in pressure in normal persons followed a definite pattern, which consisted of an initial wave of negative pressure and three subsequent waves of positive pressure. The final positive wave was produced by true peristalsis. Patients with cardiospasm had considerable spontaneous motility as well as extremely variable responses in pressure on deglutition. Though waves of positive pressure were noted occasionally in patients with cardiospasm after swallowing, a coordinated, distally traveling peristaltic wave could not be identified. The esophagus in cardiospasm apparently retains its ability to respond to distention, and, as was the case in this study, it may be caused by retained esophageal contents or by the distention of swallowed solid or liquid material.

The disturbance of esophageal motility in cardiospasm and the influence of the autonomic nervous system on the function of the human esophagus were studied by Sleisenger and his co-workers.[133] Their findings indicated that in cardiospasm the parasympathetic stimuli to the esophagus are weak and incoordinated. It was also felt that excessive or unopposed sympathetic stimulation was not an important cause of failure of relaxation of the cardia.

Olsen and his associates [134] reported 601 patients with cardiospasm. Males predominated, and there were 17 children less than 15 years of age included in the group. The chief symptoms were obstruction to swallowing, regurgitation, and pain. Hemorrhage from the esophagus occurred in 2.5%, and pulmonary complications were found in 10% of the group. The most important diagnostic procedure was roentgenologic observation. Esophagoscopy was performed only 110 times in the 601 cases. The authors stated that this examination was usually unnecessary in making the diagnosis of cardiospasm but was sometimes desirable to exclude carcinoma. Seventy-two esophagoscopic examinations were done for diagnostic purposes, and the remainder were done to aid in the treatment. In the authors' experience the passage of sounds was of more diagnostic value than esophagoscopy. Holinger, in discussion, brought out that diagnostic esophagoscopy was imperative in all cases of cardiospasm. It permits visual confirmation of the tentative roentgen diagnosis; secondly, it helps to differentiate between cardiospasm and a slow-growing benign or malignant

tumor; thirdly, esophagoscopy permits an evaluation of the cardiac region associated with the primary condition so that a more accurate therapeutic program can be carried out.

Andersen and his associates [135] reviewed 601 cases of cardiospasm and noted significant pulmonary complications in 63 (10.5%). Aspiration pneumonitis was the commonest finding, and the amount of pulmonary tissue involved varied considerably from a small localized region to a diffuse bilateral process. The roentgenographic appearance of the lesions followed a characteristic pattern. When pneumonitis was extensive and bilateral the roentgenologic appearance occasionally simulated miliary tuberculosis, silicosis, or metastatic carcinoma. Acid-fast bacilli sometimes were found. Pulmonary fibrosis was seen as the end-result of aspiration pneumonitis. Typical bronchiectasis occurred in five cases, and lung abscess was present in one instance. Four patients had acute episodes that simulated bronchial asthma; two of these were improved greatly after treatment for cardiospasm. Two patients had rather extensive emphysema. Since effective methods of treating cardiospasm are available, the relatively high incidence of pulmonary complications provides an additional reason for prompt institution of treatment after the condition has been diagnosed.

Laff [136] reported a case of cardiospasm with coexistent pneumonitis, bronchial granuloma, and broncholithiasis. The cardiospasm was considered the exciting factor for the multiple pulmonary disease, which was produced by the long-continued irritation of aspirated material. Recovery followed hydrostatic dilatation of the esophagus and bronchoscopic treatment of the disease in the bronchus and lung.

Priest and Lam [137] presented a case of a pseudodiverticulum in the upper third of the esophagus associated with achalasia. The dilatation and redundancy of the esophagus in this case seemed to be associated with the secondary formation of a pseudodiverticulum, which when excised revealed that the muscular coat was continuous with the normal longitudinal muscle of the esophagus.

Esophagoscopy was advocated as a routine diagnostic procedure in achalasia of the esophagus by Crenshaw and Booher.[138] A case was reported of a man with a 27-year history of achalasia, who subsequently developed cancer of the lower one-third of the esophagus. The diagnosis of achalasia should not be made until the presence of a growth has been excluded by esophagoscopy.

Asherson [139] reported a case of carcinoma of the cardiac end of the stomach in which intermittent cardiospasm, as revealed by radiography and esophagoscopy over a two and one-half year period, was the only sign. The only symptom was sticking of food in the cervical region.

ESOPHAGEAL SMOOTH MUSCLE TUMORS

Twenty-one cases of leiomyoma and five cases of leiomyosarcoma of the esophagus were analyzed by Johnston, Clagett, and McDonald.[140] The symptoms produced by leiomyoma were usually minimal or absent. In the patients with leiomyosarcoma, dysphagia was generally severe and frequently accompanied by pain and weight loss. The combination of roentgenography and esophagoscopy achieves a high degree of accuracy in the diagnosis of leiomyoma. Esophagoscopy was extremely helpful in arriving at the diagnosis of the exact nature of the lesion, and in only one instance was the examiner in error. In this case the mucosa was intact and the lesion was pulsating, presumably transmitted, so that it was felt that an abnormal vascular arrangement existed. An important point in the esophagoscopic differentiation of benignancy and malignancy is that in leiomyomas the mucosa is almost invariably intact, whereas in leiomyosarcomas it is usually ulcerated. Esophagoscopy was performed in 15 out of the 17 cases of leiomyoma, and although the mucosa was intact in all, some degree of esophagitis was found in 3 instances. The appearance of the mucosa was equivocal in one case, and an infiltrating malignant neoplasm was suspected and ruled out by biopsy, which was the only biopsy

done in this group. The lesion commonly protruded into the lumen of the esophagus but was pedunculated in only two cases. In 13 cases the esophagologist made the diagnosis of an intramural tumor, while in the other 2 he felt that the lesion was extrinsic. The firmness of the tumor led to the diagnosis of leiomyoma in the great majority of cases. In the four cases in which both the esophagus and the stomach were involved, leiomyoma was suspected twice. In the third case it was felt that the lesion was a traumatic diaphragmatic hernia, with compression of the wall of the esophagus by a herniated viscus, and in the fourth case the diagnosis was cardiospasm.

BENIGN TUMORS OF THE ESOPHAGUS

In reviewing benign tumors and cysts of the esophagus, Totten and associates [141] divided them into two groups: the intraluminal and the intramural. The tumors, particularly the polyps, presented considerable diagnostic difficulty, but roentgenography and esophagoscopy were helpful. Most of the polypoid tumors could be removed through the esophageal lumen, whereas a thoracic or abdominal approach was necessary in treating the intramural growths. Malignant polypoid and intramural tumors occur which clinically mimic benign growths.

Foster [142] reported the esophagoscopic removal of a pedunculated benign tumor in the upper third of the esophagus. The lower end of the polyp was grasped and delivered into the pharynx, after which a snare was passed over the polyp, and it was severed at its junction with the esophageal wall. The only complication was obstruction to breathing when the polyp was delivered in the pharynx, and this was overcome by the introduction of an endolaryngeal tube before removal of the polyp.

ESOPHAGEAL VARICES

According to Palmer,[143] patients with severe cirrhosis do not necessarily have the largest or most extensive esophageal varices. Twenty-five patients with varices secondary to portal cirrhosis were examined serially by esophagoscopy, and measurements were made of varix diameter, extent of esophageal involvement, and portal venous pressure. Enlarging varices are not necessarily indicative of rising portal pressure, the degree of diminution in the variceal severity following portal decompression does not necessarily indicate the degree of decompression achieved, and portal pressure cannot be estimated from varix severity.

Chiles and associates [144] reviewed 91 cases of ruptured esophageal varices in which hemorrhage led to death. Of the 91 cases, 11 were eliminated because the source of hemorrhage could not be found. In 31 of the remaining 80 cases, no ulceration was found and the varices were assumed to have ruptured spontaneously from increased hydrostatic pressure. In 45 cases the ulceration was of sufficient degree to have been of primary importance in the perforation of the varix. In four cases it could not be determined whether the rupture occurred spontaneously or was precipitated by ulceration. It was the authors' belief that the primary pathologic process that leads to hemorrhage from esophageal varices is increased hydrostatic pressure in some cases and ulceration of the mucosa in others. It appears that hydrostatic pressure and ulceration are related so closely that they may be assumed to coexist in any case, and consequently any therapeutic procedure must be devised with both factors in mind. Once a varix ruptures spontaneously and bleeds, the tear may be the starting point for an ulcer. The anemia, the lowered resistance to infection, and the action of gastric juice all may lead to the rapid development of esophageal ulcers. If an operation can be performed before ulceration develops, any method that will alleviate the increased hydrostatic pressure may be sufficient. Once ulceration has developed, however, not only the hydrostatic pressure must be decreased but regurgitation of gastric juice must be prevented or counteracted.

Esophagoscopy was done routinely by Brick and Palmer [145] in 150 patients with histologically proved cirrhosis of the liver. Esophageal varices were found in 95 cases. A high instance of varices, 52.7%, occurred

in cirrhotic patients who gave no history of hemorrhage. Only 21% of the cases with varices in this series were diagnosed by roentgen methods, while in the remainder the diagnosis was made by esophagoscopy. When the diagnosis was made by the roentgenograms, there were usually found very large varices when viewed endoscopically. Routine esophagoscopy was advocated for all patients with cirrhosis of the liver because of the high incidence of esophageal varices, and the earlier the presence of varices is found, the better for the patient in the event of a serious hemorrhage. Not only in diagnosis but for both follow-up study of the natural course of varices and evaluation of the success of any of the current or proposed surgical shunt procedures for portal hypertention should esophagoscopy be included for an accurate evaluation of the condition of the varices.

In a series of 44 cases of bleeding esophageal varices, 19, or 43.1%, were found by Wagenknecht and his co-workers [146] to have ulcerative lesions of the mucosa overlying the varices on microscopic section. The acid peptic action of the gastric juice on the esophageal mucosa was considered an important factor in the initiation of the bleeding from esophageal varices.

Although the endoscopist is able to localize a lesion in the esophagus with considerable precision by measuring against the superior alveolar ridge, Palmer [147] has used the transesophagoscopic attachment of a brain clip to the esophageal mucosa as an aid in certain diagnostic problems. The technique has been useful for marking the upper limit of esophageal varices, delimiting the esophagogastric junction in hiatal hernia, and marking the exact site of biopsy.

GASTROSCOPY

Shanks [148] described his technique for gastroscopy with the rigid or flexible instrument and pointed out the suitability of the otolaryngologist, with his knowledge of bronchoscopy and esophagoscopy, to perform this examination. Along with cooperation of the roentgenologist, attention to the details of anesthesia and instrumentation, adequate assistance, and proper preparation of the patient facilitate the procedure.

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Abstracts from Current Literature

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REPAIR OF TYMPANIC MEMBRANE PERFORATIONS WITH HUMAN AMNIOTIC MEMBRANE: REPORT OF FIFTY-THREE CASES. WILLIAM J. SCHRIMPF, Ann. Otol. Rhin. & Laryng. **63**:101 (March) 1954.

Schrimpf describes a new method (used in 53 cases) of closing central perforations of the tympanic membrane utilizing human chorionic membrane.

Cases selected for treatments had been free of evidence of infection for at least two weeks and showed no evidence of spontaneous improvement during that time. In all cases there was at least a small rim of tympanic membrane present around the entire perforation. The method of application was as follows: The patient's ear canal was carefully cleaned with cotton applicators. A tampon consisting of sterile cotton saturated with Grey's solution (10% cocaine hydrochloride in equal parts of 95% ethyl alcohol and aniline oil) was applied to the tympanic membrane. It is believed that this sterilizes and anesthetizes the drum. The tampon was allowed to remain in place for 10 minutes. A fine cotton applicator, lightly moistened in 50% trichloroacetic acid, was lightly touched to the edges of the perforation. About 0.5 mm. of the whitened margin around the whole circumference of the perforation is most desirable. A proper sized disc of amniotic membrane was then picked up by the tip of a fine applicator, which had previously been fashioned into a small right-angle loop. Dipping the applicator into liquid petrolatum (Mineral Oil) facilitates adherence of the membrane to the loop. It is important to apply the oiled loop to the ectodermal surface of the amniotic disc. The disc was then applied directly over the perforation through a large metal speculum. The method of preparation of the amniotic membrane is given in detail; those interested should read the original report.

Forty-eight perforations were successfully closed. The length of time necessary to effect a closure varied from 7 to 200 days, with an average of 43 days required for closure. The average improvement in the air-conduction audiogram in all frequencies was 18 db. Of the cases treated, 81.25% showed a negative Rinne test before closure. Of those who previously showed a negative Rinne test, 75.6% changed to a positive Rinne test after closure. A case of perforated tympanic membrane following a fenestration operation and the benefits resulting from closure by this new method are cited.

The failures of closure in three cases were due directly to repeated infections. The infections resulted both from the inadequacy of the treatment in removal of all foci of infection from the middle ear, mastoid cavities, Eustachian tube, and upper portion of the respiratory tract and from the inability of the patient to prevent foreign material, especially water, from entering the middle ear via the canal. Two failures could not be explained. STEELE, Kansas City, Kan.

ANATOMY AND HISTOLOGY OF THE EXTERNAL EAR IN RELATION TO THE HISTOGENESIS OF EXTERNAL OTITIS. LAWRENCE H. SOPHIAN and BEN H. SENTURIA, Laryngoscope **64**:772 (Sept.) 1954.

The external meatus is lined with stratified epithelium, with a corium of variable thickness beneath. There are hair follicles and sebaceous and apocrine (ceruminous) glands. The latter have long and twisted ducts.

The blood vessels, both arterial and venous, are described, as are the nerves affecting this area, and also the lymphatic system. The method of study is explained, and there are numerous histological illustrations showing the various structures. There is a rich vascular tunic lying deep to the glandular area. Its presence accounts for marked vascular reactions similar to those of the nasal mucosa. These reactions cause tissue and nerve tension, suppression of secretion, and necrobiosis. Such, it is emphasized, can be initiated not only from infections but also from inflammatory, allergic, or endocrinic causes. This may explain some of the contradictory observations reported by workers attempting to determine the etiology of various forms of external ear disease.

HITSCHLER, Philadelphia.

HYDROCORTISONE ACETATE AND NEOMYCIN IN OTIC INFECTIONS. BEN H. SENTURIA and VERNA ALFORD, Laryngoscope **64**:834 (Oct.) 1954.

One hundred fourteen ears were treated with an aqueous suspension (1.5%) and/or an ointment(1.5%) containing neomycin and hydrocortisone acetate (Compound F). The conditions treated included acute and chronic external otitis of the neurogenic and chronic diffuse types, chronic otitis media, and recalcitrant infections of postfenestration and postmastoidectomy cavities. It is pointed out that a diagnosis of the particular kind of otitis present is helpful. The drugs mentioned act on both Gram-positive and Gram-negative bacteria, but not against viruses of fungi. Very little bacterial resistance seems to develop, and sensitivity is rare.

In the neurogenic cases, itching, scaling, and, sometimes, weeping are common. Both the symptoms and signs disappeared remarkably well, even in old chronic cases. In the diffuse external otitis, commonly seen in the hot humid weather, the results were equally satisfying. Old cases of postoperative discharging cavities, long thought incurable, likewise became clean. There were some failures, but these were due in the most part to the presence of a fungus. In such cases the medication was replaced with a fungicide for a few days. The neomycin-hydrocortisone ointment was used in the external otitis cases; the aqueous suspension, in the otitis media and postoperative cases.

HITSCHLER, Philadelphia.

METHODS FOR DETECTING AUDITORY DEFECTS IN THE YOUNG: FIVE MINUTE "ALERT." EDMUND PRINCE FOWLER SR., New York J. Med. **54**:3095 (Nov. 15) 1954.

Fowler is Chairman of the Subcommittee on the Hard of Hearing and Deaf of the Medical Society of the State of New York. This paper was read at the Annual Meeting, Pediatrics Section, May 14, 1954. Hearing tests for school children are fundamental to the child's further education, but only "supplemental" in testing the infant. Elaborate tests with expensive machines require special training of the examiner. They are often unnecessary or overemphasized. The degree and pattern of deafness are, of course, basic to further management. It may be difficult to measure hearing in a child below the age of 5, but by making it a sort of game, a test may become fairly accurate. "Children with no defect in hearing . . . have a 10 to 15 per cent greater hearing capacity than adults. This fact is commonly forgotten." We must rely upon the acuity of observation in parents of children who are of preschool age. Environment is the principal factor. A child playing in a room adjacent to his elders may be so intent upon play that he does not answer a question or command, but he is not so often deaf as inattentive. Nearness or farness may be determinative of hearing degrees. If he does not hear a passing fire engine or automobile, a church bell or barking dog, there is a suspicion of deafness if inattention can be discounted. It is important to know whether the deafness is irreversible; if so, it is well to send the child to a nursery school for the deaf at 2½ years or before 3 years.

I. W. VOORHEES, New York.

MOBILIZATION OF THE STAPES TO RESTORE HEARING IN OTOSCLEROSIS. SAMUEL ROSEN, New York J. Med. **55**:69 (Jan. 1) 1955.

Rosen is a surgeon at Mount Sinai Hospital, New York City. He read this paper before the New York State Medical Society Meeting May 14, 1954. Attempts to mobilize the stapes date back to more than 50 years ago, but were abandoned. No substitute was undertaken, however, until fenestration made its appearance. Rosen's operation is described as a "simple procedure." Nevertheless, he recommends that one practice on at least 50 cadavers before trying it out on the living. With the patient under local anesthesia, the stapes is exposed, the lower half of the eardrum is lifted out of it sulcus and turned upward. Special, fine instruments are used to mobilize the stapes, which is seen under a Zeiss binocular loupe. These are nine in number and are illustrated in the original article. After the stapes is mobilized, the eardrum and skin are allowed to fall back in place. Healing requires about one week, during which time antibiotics are given. The patient walks about immediately after operation or within 24 hours, without dizziness. No diet restrictions are necessary in the normal patient. Five cases are here reported in which hearing has been improved or restored and maintained for from 16 to 25 months! Charts are shown to verify the findings.

ABSTRACTOR'S COMMENT: If this operation can be learned thoroughly and repeated by the "average otologist," a surgical miracle is at hand. The onus will be placed upon fenestration, which is far from a simple operation and sometimes has unpleasant consequences. As Rosen describes it, his procedure has great merit and is sure to be tried out by others. Comparable results must, of course, be weighed in the scale of time. I. W. VOORHEES, New York.

OBSERVATIONS ON THE CIRCULATION IN THE COCHLEA. J. C. SEYMOUR, J. Laryng. & Otol. **68**:689 (Oct.) 1954.

This is an excellent piece of investigation into the blood circulation of the labyrinth, particularly the spiral ligament of the cochlea, and the various fluid systems, with special reference to the correlation of specific pathological findings with departures from the normal physiological states.

The importance of the presence of a vessel recently described as a metarteriole coursing as a preferential or thoroughfare channel, through the capillary bed from terminal arteriole to venule, is described in relation to the function of this channel and its tributaries.

The experimental observations of the physiology of these minute vascular channels and their reactions to drugs such as Adrenalin and histamine are discussed in detail. In 7 of a group of 19 animals, prolonged sympathetic stimulation produced a marked concavity of Reissner's membrane. A number of dilator drugs were investigated and nicotinic acid proved to be the most efficient. Priscol had practically no effect on the cochlear vessels. The rate of blood flow differs in the various vessels. It slows in the capillaries of the spiral ligament but is slowest in those of the stria vascularis. This allows for maximum oxygen and metabolic exchange, which is essential for the organ of Corti; since this structure is not provided with vessels of its own, it follows, then, that since the strial network is continuous from apex to base oxygen tension will fall from apex to base and that blood borne toxins will tend to concentrate at the base. It may be this fact that predisposes the basal whorl to damage rather than malfunction of the separate specific vessel supplying part of the basal whorl.

The production and absorption of endolymph are discussed in detail. It is the author's opinion that endolymph production and absorption tend to be largely localized in the respective endolymph spaces and that the function of the saccus endolymphaticus, which secretes endolymph, is to ensure complete filling of the phylogenetically older utriculus and semicircular canals.

A vascular factor as a major contributory cause of perceptive deafness and as an underlying cause in Ménière's disease is supported. The relatively small size of the internal auditory artery and the absence of cochlear vascular reserve lend added support to this hypothesis.

LEJEUNE and NORMANN, New Orleans.

MÉNIÈRE'S DISEASE. TERENCE CAWTHORNE and A. B. HEWITT, Proc. Roy. Soc. Med. **47**:663 (Aug.) 1954.

The Feb. 5, 1954, meeting was under the presidency of R. R. Simpson, F.R.C.S. Mr. Cawthorne gave a brief résumé of the life and work of Prosper Ménière, of Paris, who, in 1861, published a series of papers on disordered labyrinth. Ménière had an interesting and eventful life as accoucheur to the wife of the Pretender to the French throne. He was a friend of Balzac and Superintendent of the Deaf and Dumb Institution, but it was in the final year of his life that he announced the discovery which bears his name. The follow-up was sporadic until Hallpike and Cairns in 1938 noted disturbed endolymph function on the unilateral side. The production and disposal of endolymph, now commonly called "hydrops," is out of balance. Other labyrinthine disorders resemble this syndrome, and the differential diagnosis may be obscure at the first sitting. Out of 1902 cases of vertigo referred to Cawthorne and his associates, 61% were of labyrinthine origin, and the conclusion is that practically all vertigo relates in some way to the internal ear. Central causes are set down as epilepsy, disseminated sclerosis, certain tumors of the temporal lobe and others in the posterior cranial fossae and cerebellopontine angle, thrombosis of the posterior-inferior cerebellar artery, and migraine.

In the peripheral groups, under trauma, persistent vertigo may follow injuries to the head (Cawthorne and Cooksey, 1946). Vestibular neuronitis is associated with loss of vestibular function, but auditory function usually remains. Linkage of sepsis from respiratory infections has been sought, but is as yet undetermined. However, an old chronic middle-ear infection does invade the labyrinth, as every otologist knows, but such incidents should probably not be called by the Ménière cognomen. Incidence is probably not so rare as is sometimes averred. The

preponderance of males over females is only slightly greater. At the menopause, however, females seem to be more often affected than in the similar age of males. Most persons have their first attack before age 50. It is not always unilateral, but the other ear may not be involved for many years (37 years in one case). These authors do not favor allergic conditions as a common cause (under 5% in their series), but this certainly can be disputed by many American observers.

"Distortion of hearing" in endolymphatic hydrops was noted in about half of the series. It is noticed in loud shrill and musical sounds, with a loss of musical appreciation, from which recovery is common, as the symptoms disappear and an interval between attacks is established. Pure tones may be heard much better than speech, which may be a conglomeration of nonunderstandable jargon. "We regard distortion of hearing as a valuable clue to the nature of deafness." It may be possible to make a diagnosis of hydrops on the cochlear symptoms and signs alone. Deafness is found in the lower tones. Diagnosis of Eustachian-tube blockage may be false; "in only one case out of 900" was such blockage confirmed! However, blockage may be associated with "giddiness." Hydrops may develop after fenestration (Shambaugh and others). "Vestibular function should always be tested, since it may give the only physical sign of a disordered vestibular labyrinth."

Distension of the endolymphatic system is the result of recurrent "bouts" of endolymphatic hydrops. Attacks may appear in groups, with intervals of complete freedom. During the quiet phase, all signs and symptoms may be absent or nearly so. A rise in endolymphatic pressure without proper outlet to balance this distortion is said to "squeeze the blood out of the capillaries."

Treatment is the following: 1. Sedation, Dramamine or Avomine, which may not prevent attacks but may reduce their severity. 2. Antiretentional regimen to reduce the intake of salt and fluids, with a low sodium diet. 3. Vasodilatation. This is sought by drugs such as histamine, procaine, or nicotinic acid or by paralyzing the cervical sympathetic nerve. Surgery will relieve the tinnitus at once, and the vertigo is lessened. Distortion of hearing may persist but is less pronounced.

Injection of the stellate ganglion seems not to have been effective. Likewise, section of the chorda tympani (Rosen) has not been useful to Cawthorne. Sympathectomy is still in the experimental stage, and should be so regarded when making a decision to operate. 4. Destructive procedure. Streptomycin, because of its selective action on the internal ear, has been tried, but it will affect both ears, with sad results, particularly in the aged, whose infirmities are so plentiful. 5. Drainage of the saccus lymphaticus seems logical enough and has had some success, but resultant fibrosis may defeat the original purpose. 6. The labyrinth can be destroyed by alcohol injection or diathermy or labyrinthectomy. The simplest procedure is to remove a portion of the membranous labyrinth from the horizontal canal. This is favored by Cawthorne, but we must remember that it results in a completely dead labyrinth. 7. Section of the vestibular nerve causes such irreversible distortion that it is not recommended.

Discussion of this paper was carried on in extenso and cannot be abstracted here. There are some 40 references to the literature, with a fair sprinkling of the names of American authorities.

I. W. VOORHEES, New York.

DISCUSSION: CONGENITAL DEAFNESSS. A. A. J. VAN EGMOND and OTHERS, Proc. Roy. Soc. Med. **47**:937 (Nov.) 1954.

The Section on Otology convened on March 5, 1954, under its president, R. R. Simpson, F.R.C.S. Prof. van Egmond defined congenital deafness as a partial or complete loss of hearing transmitted through heredity or caused by environmental influences during prenatal life and leading to mutism. He sets down two groups: (*A*) Dominant inner-ear deafness, which develops usually at middle age. It is congenital only in the sense of being one of the six characteristics of the hereditary syndrome first described in 1951 by Waardenburg. According to Mendelian laws, inner-ear deafness will be present in every generation, with a 50% chance for the offspring to acquire it also. (*B*) Sporadic recessive deafness, so called because in a seemingly healthy family only one child will become affected, cause unknown. Consanguinity is, of course, a factor. In dominant hereditary deafness, development of the bony cochlea becomes arrested, with malformations in the soft cochlea, with an intact acoustic nervous system. But in recessive sporadic deafness, all soft parts are affected, i. e., nerve trunks and fibers, central nuclei and tracts with the cochlear bone intact. In each group Corti's organ is damaged, with, therefore, varying degrees of deafness. Congenital atresia auris causes congenital deafness if it is bilateral. A hereditary element is possible, but damage in utero is likely. Anatomical irregularities are

confined chiefly to the middle ear, and so the deafness is conductive and may be improved by fenestration. Erythroblastosis fetalis may also cause congenital deafness. After birth, icterus gravis may supervene and a complex called kernicterus may appear. Such lesions may appear in the nuclear pathways, giving rise to severe perceptive deafness. Environmental factors are found during the 8 to 12 weeks of pregnancy while organs and systems are forming, and cells still undifferentiated are highly vulnerable. Virus infections may cause both deafness and cataracts. Syphilis is a well-known cause of congenital deafness, but may appear at the 8 to 12-year age period. Diagnosis of congenital deafness depends chiefly on history as stated by the parents. The importance of prenatal health in the expectant mother is of the essence. Infections of every kind must be avoided. Immunization against rubella and certain other infections can now be obtained by careful medical management. At this juncture, Mrs. Florence Cavanagh held forth on the Rhesus factor. Some 85% of the population are Rhesus positive. The other 15% are Rh negative. The Rh baby manufactures his own rh-ve erythrocytes, but his serum contains antibodies from his mother, which combine with his red cells and cause hemolysis, resulting in anemia and jaundice. While apparently normal at birth, such a baby in a few hours becomes deeply jaundiced, drowsy, cyanotic, and convulsive. There is "cerebral cry," spasticity, and athetosis. Postmortem shows pigmentation in the brain. The auditory pathways are deeply involved, and the cochlear nuclei show pathology. The treatment in such instances must be immediate and carried out by an immunologist because of the intricacies of the situation.

Rubella is a cause of severe deafness, according to Prof. John R. Lindsay and Mr. M. Spencer Harrison, both of whom spoke in this symposium. While the bony labyrinth may be normal, Reissner's membrane may be collapsed and adherent to Corti's organ. The striae vasculares are damaged or "almost absent." There are changes in the tectorial membrane, but cells of the spiral ganglion and the nerve fibers are seldom, if at all, affected. The general discussion brought out the fact that rubella in the first trimester of pregnancy produces grave changes in the fetus, especially in the endolymph, utricle, and saccule, and incomplete development of Corti's organ. Collapse of the saccule may have occurred during the mother's attack by rubella. A blood-borne toxin or virus is held responsible for changes in the fetal anatomy. Carrying on the symposium, Dr. L. Fisch discussed hemolytic diseases in the newborn infant based on clinical and pathological observations. Some 30 cases were reviewed, which fell into two groups: one with a fairly moderate loss of high frequencies, the other with a severe loss of high frequencies. Emphasis was laid on the neurological findings in relation to congenital deafness. It is easy, he said, to interpret dullness or mental deficiency in these children when, in fact, they may be mentally normal! All children who survive hemolytic disasters must be tested thoroughly to determine the kind and degree of deafness, and what can be done to improve the hearing.

I. W. VOORHEES, New York.

PSYCHOGENIC DEAFNESS. P. F. KING, Proc. Roy. Soc. Med. **47**:941 (Nov.) 1954.

King reports from the Department of Otorhinology, Central Medical Establishment, Royal Air Force, London. The term "psychogenic deafness" is convenient but conveys no definite notion of the intricacies of certain aural dysfunctions. For example, there is so-called "functional deafness," which is characterized by (*a*) loss of the faculty of discrimination of Kopetzky, (*b*) organic deafness with hysterical overlay, and (*c*) pure hysterical deafness with no sign of organic defect. A second classification is entitled malingering, either malingering associated with hysteria or with organic defect, or "simple malingering."

The loss of capacity for discriminative listening is common to all of us at times, especially in older people and in children who are absorbed in play. Such deafness may be real, of course, but may exist with fairly normal hearing. Functional deafness may exist under combat conditions without the subject being aware of it. Hysterical deafness may exist alone or with organic deafness. There may be a history of previous aural disease. Detection of deafness in malingering may be difficult, especially if it has an organic overlay. Unilateral deafness is commoner in organic cases; the malingerer is likely to claim binaural loss of hearing. The demeanor of the "suspect" should be carefully watched. It may help in coming to a conclusion. All ordinary tests may be of little help. Audiometry may give confusing results. The "efficiency test" is helpful at times. The subject listens to recorded speech at an intensity of 106 db. in a background noise of 100 db. The scores obtained are far below those obtained in patients with advanced perceptive loss. The psychogenic patient responds in an entirely different manner from one who has organic loss. Vestibular tests are of little or no value in estimating auditory function. Supplemental examinations by a psychiatrist may assist the otologist in coming to a conclusion.

ABSTRACTOR'S COMMENT: In insurance cases and under military conditions, every otologist will work out some form of "catching the patient off guard." There are many such schemes which are known to each examiner. The difficulty arises when the examinee is as familiar with such matters as is the examiner! The smart ones "read up" on malingering before submitting to tests.

I. W. VOORHEES, New York.

THE PATHOLOGY OF OTITIS MEDIA. J. FRIEDMAN, Proc. Roy. Soc. Med. **47**:942 (Nov.) 1954.

Dr. Friedman is connected with the Institute of Laryngology and Otology, University of London, and the Royal National Throat, Nose and Ear Hospital, London. The occasion was a meeting on June 10, 1954. The purpose of the study was to compare the present pathologic changes with those of the prepenicillin era. Guinea pigs were inoculated into the middle ear with cultures from the principal causative organisms. Also, bone chips from recent mastoid operations were searched for bacterial and tissue changes. The organisms found were D. pneumonae, S. beta hemolyticus, S. aureus, S. albus, C. albicans, P. pyocyanea, and B. proteus. The findings were in general not different from the well-known classic types. It seemed, however, that the streptococci infections were somewhat milder. Of 11 guinea pigs, 7 infected with hemolytic streptococci died within 14 days. As for human otitis media, 215 operated on cases were studied, but no evidence was brought forth that the pathological changes were different from what is already known about them. As for chronic otitis media purulenta, Friedman suggests the phrase "cholesterol granuloma" for those patients with cholesteatoma. Antibiotics are helpful plus, of course, surgery, when indicated. Pyocyaneous infections are resistant to antibiotics.

I. W. VOORHEES, New York.

FACTORS WHICH INFLUENCE THE HEARING RESULT IN THE SURGERY OF CHRONIC OTITIS MEDIA. IAN B. THORBURN, Proc. Roy. Soc. Med. **47**:944 (Nov.) 1954.

This is a report on 188 radical and modified radical mastoid operations from 1947 to 1953, inclusive. Modified I clears out all mastoid cells, removes the bridge and outer tympanic wall. The tympanum is not disturbed. Such cases are acute or subacute. Modified II recognizes chronic infection with perhaps cholesteatoma, where "there is a tissue barrier between the disease and tympanum." Modified III removes the incus and head of the malleus to get beyond the disease (cholesteatoma). Modified IV calls for removal of incus and malleus in toto, but an attempt is made to retain remains of drum and meatal skin "to form a closed potentially mobile drum, or to cover the round window." This ends the conservative radical operations. Radical I is the usual "complete radical," but with no removal of the medial tympanic wall mucosa. Radical II is essentially the Lempert procedure. Hearing is charted before operation and is normal, good, fair, poor, or useless. Each group is studied as to pathology present at operation, and hearing results. To sum up, "Only 8 out of 94 radical cases had useful hearing; . . . but all were healed and in 6 a new mobile false tympanic membrane had formed."

ABSTRACTOR'S COMMENT: Here, in America, there is a general feeling that a "false drum" diminishes rather than improves the hearing. However, one may get a wrong impression from reading the above, since it is not possible to follow the operative technique precisely.

I. W. VOORHEES, New York.

ELECTRIC ENCEPHALOGRAPHY IN OTOLOGY. A. APPAIX and ROBERT AVIERINOS, Rev. laryng. **75**:633 (Sept.-Oct.) 1954.

The authors have employed electroencephalography in a diverse series of patients. Among these were cases with endocranial involvement in association with otitis media, particularly brain abscess, cerebellar abscess, or psychomotor epilepsy following a suppurative otitis media. Their impression is that in this group of cases definite findings can be obtained and that with a better knowledge of the role of the electroencephalogram real diagnostic value can be associated with this test.

The examination of 10 deaf-mute children failed to reveal conclusive results as to whether the children were deaf. However, the authors believe that with further studies there may be a possibility of locating the site of the deafness.

The EEG is of great value in the diagnosis of lesions of the pontocerebellar angle.

An interesting finding was observed in the study of tinnitus. Ninety per cent of the patients produced identical electroencephalographic tracings indicating a neuron hyperexcitability. This test may be thus of some value in determining the physiopathology of tinnitus and, secondly, of establishing this symptom on an objective basis.

The EEG was inconclusive in cases of chronic progressive deafness or in Ménière's disease.

Two patients who had familial deafness associated with Lobstein's syndrome presented abnormal findings suggesting mesocephalic pathology. In conclusion, the authors feel that a wider use of EEG will be an important adjunct in the laboratory procedures and so perhaps be of real value in diagnosis.

PERSKY, Philadelphia.

A CASE OF A HUGE OSTEOMA OF THE MASTOID. A. CLAROS and R. PULIDO, Acta oto-rino-laring. ibero-am. **5**:370, 1954.

The authors, after a historical review of osteoma of the mastoid cavity, describe a 30-year-old patient who complained of a swelling of the left mastoid region for the past 16 years. This progressed very slowly without any apparent symptoms other than a mild deafness. They removed an osteoma weighing 37.5 gm. from the left mastoid cavity. There were not any postoperative complications. The patient left the hospital completely cured within 15 days.

PERSKY, Philadelphia.

RECENT ADVANCES IN THE STUDY OF THE LOUDNESS RECRUITMENT AND ALLIED PHENOMENA. J. D. HOOD, Acta oto-rhino-laryng. belg. **8**:27, 1954.

Hood comments that the extensive literature on the problem of recruitment abounds with conflicting and, in some cases, misleading reports. He reviews the principles which govern both the design of test procedures for the demonstration of recruitment and the interpretation of results. First, he presents a lucid account of how to do and how to plot the results of studies done with the binaural loudness balance technique. He compares the results on the same ears using a different type of technique. In this latter method, instead of using short bursts of pure tones, he uses continuous tones simultaneously applied to both ears instead of alternately. The results markedly differ from those obtained with the classic method. In one of the impaired ears the loudness recruitment shown by binaural loudness balance testing was completely abolished, and in the other ear it was reversed. This demonstrates that the manner in which a test is given determines the results.

To explain the different results with continuous and simultaneous stimulation, Hood refers to the studies of Mathew on adaptation as it occurs in single end-organs. A stimulus applied to an end-organ produces an action potential response consisting of an initial high frequency discharge, known as the on-effect. This is brief, in the order of 0.2 seconds, and is followed by a slow decline in the discharge frequency with time. This decline is termed adaptation. If a continuous stimulus is used, an accelerated adaptation occurs, that is, a rapid relapse of the response. However, the on-effect remains normal. Hood believes that on-effect normality and abnormal rapid relapse are also characteristic of the diseased end-organ of hearing, particularly the end-organ affected by Ménière's disease. On-effect normality in such an ear will produce the phenomenon of loudness recruitment provided that short and intermittent stimuli are used. If sustained stimuli are used, the relapse phenomenon will also occur in this type of ear. Hood proceeds to explain how adaptation occurs in the end-organ, using as an analogy for this process of equilibration the filling and emptying of a water tank. He summarizes this analogy by concluding that in end-organ disease the initial response to short duration tones may approximate or even exceed the normal if the stimulus is continued, and, indeed, it may show an abnormal tendency to relapse, the characteristic which seems likely to be the result of hair-cell disease.

The loudness scale in an affected ear is compressed, and this has as its inevitable corollary a corresponding reduction of the intensity difference limen. If a continuous stimulation method is used, the difference limen under these conditions is often increased and the loudness scale for the affected ear may expand instead of being compressed.

Hood demonstrates that relapse is unlike physiological fatigue, since it does not depend upon intensity but only upon the activity of the individual cochlear receptors concerned; it occurs at all intensities, including threshold. Hood's results are at variance with those of Reger and Kos, because of their failure to recognize the difference in loudness recruitment that may result from continuous stimulation, particularly with the Békésy type of audiometer. Hood reports a case in which there is marked relapse at low threshold levels in an ear with Ménière's disease.

In the same ear using a continuous stimulation the difference limen is greater than that for the normal ear and the loudness recruitment was abolished. Relapse with end-organ disease takes place with such rapidity that no on-effect at all is initiated when intensity is increased gradually. Hood concludes that loudness recruitment is only one element in a complex derangement of cochlear function due to end-organ disease. The other factor is the relapse phenomenon which occurs in response to tones of long duration. Any technique which involves sustained stimulation in studying recruitment will bring into play pathological adaptation of the sustained response, which involves the elimination or even reversal of recruitment. SATALOFF, Philadelphia.

TRANSMASTOIDAL CISTERNAL DRAINAGE AND ITS SIGNIFICANCE IN SEVERE OTOGENIC MENINGITIS. A. BLOHMKE and R. LINK, Acta oto-laryng. **44**:313 (July-Aug.) 1954.

The development and spread of purulent otogenic meningitis are discussed in detail. This is followed by a discussion of the general anatomy of the enlarged subarachnoid spaces (cisterns) at the base of the brain. Attention is centered upon the lateral pontine cistern next to the pons. This is a key position, for it is in a pathway between the temporal bone and an endocranial extension of an infection of the same. The opening of this cistern through the anterior right-angled corner of Trautman's triangle is described. This effectively drains off infected meningeal fluid through its shortest course. This stimulates further production of bacteriocidal fluid, with a drop of endocranial pressure. This may also act to speed dispersion of antibiotics from intra-lumbar injections.

With the use of antibiotics alone, the mortality in otogenic meningitis is too high (20%-40%). With the use of this "focused" method 90%-100% cures are possible. There is a special value of this approach in drainage of an empyema of the endolymphatic sac as well.

ROBERT LEWY, Chicago.

THE HISTOLOGY OF BELL'S PALSY. L. B. W. JONGKEES, Acta oto-laryng. **44**:336 (July-Aug.) 1954.

The author presents a case in which there was an exceptional opportunity to study a biopsy of the chorda tympani nerve in an instance of Bell's palsy. He feels that the evidence indicates that the pathophysiology is an acute vascular disturbance as the original insult. This is followed in turn by exudation of fluid and swelling of the nerve. Since the nerve is in a carefully constricted area, secondary vascular disturbances result. This produces a progressive vicious cycle. The fact that some sterile fluid is found in the mastoid spaces in these cases fits this hypothesis. Weiss' experimental results on the histology of nerve packed into too small a space add further weight to the argument.

The healing process may be aided by drugs or efforts to end the vasodilating effect. This would include the use of nicotinic acid, histamine, stellate ganglion block, etc. In a degenerated nerve, connective tissue may form. Thus the possibility of complete restoration becomes smaller and smaller the longer compression remains.

ROBERT LEWY, Chicago.

NERVE GRAFTING AND NERVE SUTURE IN POSTOPERATIVE FACIAL PALSIES: A REPORT OF SIXTY-NINE CASES. KARSTEN KETTEL, Danish M. Bull. **1**:157 (Nov.) 1954.

Among 260 cases referred to the author in which a balance-duel operation was indicated, 69 were due to a surgical lesion of the facial nerve of such a grade that a nerve graft or nerve suture was needed. One patient had been operated upon recently, and one could not be traced. The rest, 67 cases, had been reexamined by the author.

If the palsy arises in direct conjunction with an operation or accident, the site of lesion should be explored without delay and the repair undertaken. If the palsy arises after an interval of freedom, the prognosis on the whole is good.

It must be borne in mind that not even the most successful operation will be able to restore function completely. The material can be divided into two groups:

A. Cases in Which No Degeneration of the Muscles Had Taken Place and in Which the Operation Was Successfully Performed.—Only when these conditions are fulfilled, good results can be expected. To this group 53 cases belonged.

A clinically satisfactory result was obtained in 48 cases, or 90%. In none of the cases was the palsy noted when the face was at rest. Seven patients could smile and laugh, but not close the eye completely, which, however, did not cause any trouble. Thirty-five could smile, laugh, and

screw the eye tightly up, and the last six could, in addition to this, wrinkle the forehead more or less. Insufficient reinnervation was noted in four cases (8%), while in one patient no reinnervation at all took place. These five operations were performed before the author started using magnification for the coaptation between nerve and graft.

B. Cases in Which the Muscles Had Degenerated Partially at the Time of Repair or in Which Insurmountable Technical Difficulties Were Encountered.—To this group 14 patients belonged. All the patients had, of course, been told in advance that in their cases the operation had to be regarded as an experiment.

The technical difficulties applied especially to extratemporal repairs in cases in which the palsy was due to removal of a retromandibular tumor, a tumor of the parotid gland, or to a gunshot lesion. In these cases the bed consisted of scar tissue, where only minor strands of the distal end of the facial nerve could be found.

A repair should be tried at any time provided the muscles have been kept alive, as indicated by a strong response to the galvanic current, and provided the site of lesion is surgically accessible, which in practice means distal to the geniculate ganglion.

The length of the graft has varied from 4 to 50 mm., some of the best results being obtained with long grafts. The time when the first signs of returning mobility were noted varied from 4 to 24 months, the average being 10 months.

The importance of an adequate after-treatment is stressed.

AUTHOR'S SUMMARY, Hillerød, Denmark.

DEAFNESS AND DEAF-MUTISM IN CHILDREN, WITH SPECIAL REFERENCE TO RUBELLA. BERTEL IVSTAM, Nord. med. **49**:208 (Feb. 6) 1953.

The author reports on a study of 496 children born from 1935 to 1942 and attending Swedish schools for deaf-mutes. The study was performed in 1951. Congenital deaf-mutism was due to heredity in 150 cases, to antenatal rubella in 31 cases, and to an unknown genesis in 238 cases. In 77 cases there was a postnatal acquired deaf-mutism due to birth trauma, erythroblastosis, meningitis, and different kinds of infections. The author maintains that there exists an association between the incidence of maternal infection with rubella during the early months of pregnancy and the incidence of congenital deaf-mutism. Out of the 29 children of mothers who had had rubella during the first four months of pregnancy, only 1 was found to have congenital defects (organic heart disease and dental malformation). The risk of congenital anomalies in infants of mothers infected with rubella during the first few months of pregnancy is therefore small and does not justify abortion.

WALLGREN, Stockholm [A. M. A. AM. J. DIS. CHILD.].

Pharynx

INFECTIOUS MONONUCLEOSIS TREATED WITH ACTH. ARTHUR J. REDMOND, New York J. Med. **54**:3411 (Dec. 15) 1954.

Captain Redmond reports from the hospital at Sampson Air Force Base. He is "on leave" from the University of Rochester School of Medicine. These five case reports are of interest to E. N.T. men because of the probable origin of this malady in the areas most commonly observed in this specialty. We find references to "red and boggy pharynx, cervical glands, sore throat and stiff neck" as antecedents. The diagnosis, of course, cannot be made from such symptoms and signs, but they may well emphasize the importance of a complete blood study in such instances. The differential count, the heterophile agglutination, the prothrombin time, total cholesterol, cephalin flocculation, etc., are laboratory items of first degree. Adrenocorticotropic hormone was given, 20 mg. in 1000 cc. of 5% dextrose in distilled water, by slow intravenous drip. There "was sudden and dramatic loss of toxicity, fever, . . . and a return of appetite and well-being." There is no claim that this drug changed the lymphadenopathy, splenomegaly, or liver involvement. This disease is a killer and has often been declared to be irreversible, but in these days some clinical cures are possible. However, hepatitis is still obstinate and requires weeks and months for improvement.

ABSTRACTOR'S COMMENT: The rhinolaryngologist wishes to know whether he can reduce the degree of infection at the portal of entry. The nature of the organism or virus is not presently understood. What results from antibiotics? They seem to have no effect, according to the literature. Which local antiseptics might we try?

I. W. VOORHEES, New York.

DISCUSSION ON THE MANAGEMENT OF HEMORRHAGE FOLLOWING TONSILLECTOMY. D. WALKER ASHCROFT, Proc. Roy. Soc. Med. **47**:945 (Nov.) 1954.

The meeting was held on May 7, 1954, under the presidency of C. P. Wilson, C.V.O., F.R.C.S. Mr. Ashcroft had heard of six deaths "recently following tonsillectomy." Some deaths may be due to surgical shock, drug dyscrasias, or "misadventure." Hemorrhage may happen to any operator, and its control may demand more skill than the operation itself. The author recognizes three types: 1. Reactionary, occurring within the first 24 hours. 2. During convalescence, from separation of the primary slough, usually on the fifth night or sixth day, possibly due to ligature loss. 3. True secondary hemorrhage from sepsis or sloughing of a blood-vessel wall. Certain factors favor hemorrhage in the preoperative, operative, and postoperative stages, for example, the type of patient, such as the plethoric, with a short thick neck; heavy smokers and drinkers, and highly excitable persons. "Red-headed females are suspects . . . also freckled children." A history of bleeding following tooth extraction or any slight injury calls for blood studies, with an eye to hemophilia. A previous severe tonsillitis or peritonsillar abscess recently experienced invites postponement for two or three weeks. Infections of the nasal fossae and sinuses, and a cold contraindicate operation. Jaundice often is accompanied with decreased fibrinogen, and, hence, delayed clotting of the blood. Menstruation is an unfavorable time for tonsillectomy. Toxic conditions found in nephritis, rheumatism, thyrotoxicosis, diabetes, and diphtheria must be recognized as pejorative. Pyrexia is a contraindication. This negation also applies to buccal ulcerations, stomatitis, gingivitis, etc. Weather conditions (heat wave) may favor bleeding.

The author speaks further of imperfect clot formation, the slipping of ligatures (he recommends reef knots instead of slipknots), etc. There are artificial means of helping to control bleeding at operation, such as vasoconstrictors and coagulants, which may have latent or postoperative untoward effects such as those of Adrenalin. Coagulating agents recommended at operation are friar's balsam, Protargol, hemostatic serum, snake venom, and thrombin. After operation, obstruction to respiration must be carefully avoided, such as tongue swallowing and clots at the glottis. Direct tube aspiration may be lifesaving. Cyanosis is always a dangerous sign. Forward posture is important, and special nursing "until the patient comes out" must be the rule. Diet is best maintained by cold fluids, and bed confinement for at least 24 hours, with no floor privileges, should be enforced. However, one ought to reflect that bed-pan usage may be even more strenuous than walking to the lavatory.

Further details of management do not differ very much from accepted practice in the U. S. Quite a lot of space is given to reactionary hemorrhage and laboratory studies of the blood in connection therewith. The author doubts the advantage of ligation of the external carotid because of the great collateral circulation, but he does note that blood transfusions may be lifesaving in urgent cases. He says that there must be no complacency about these hemorrhages, but prompt and decisive action.

ABSTRACTOR'S COMMENT: The detailed study of this problem, and the lively discussion in the symposium, goes to prove that the last word may never be said about tonsils and adenoids, and their management.

I. W. VOORHEES, New York.

GLOSSOPHARYNGEAL NEURALGIA. M. PERMIN, Acta oto-laryng. **44**:348 (July-Aug.) 1954.

Glossopharyngeal neuralgia was first described by Weisenberg in 1910. The symptoms are similar to those of trigeminal neuralgia, except that the pain localization is different. The pains may be lancinating or cutting in the region of the tonsil area and the base of the tongue and radiating toward the ear. They may be produced by speech, deglutition, or yawning and so severe that a patient may be afraid to speak, eat, or swallow. Therapy may be by intracranial section of the nerve, extracranial section, or by vitamin B_{12} injections. Differential diagnosis includes cerebellopontine angle tumor and malignancy of the tonsil area.

ROBERT LEWY, Chicago.

Larynx

CONGENITAL DISORDERS OF THE LARYNX. DANIEL C. BAKER JR., New York J. Med. **54**:2458 (Sept. 1) 1954.

Baker is a surgeon on the E. N. T. Staff of the Columbia University Medical Center. He states that congenital disorders of the larynx "are not unusual." The diagnosis is easy, but the problems therewith may be formidable. They may be classified as stridor, cysts, webs, paralyses,

stenosis, angiomas, and tumors. The symptoms are obstructive dyspnea, hoarseness, stridor, weak or absent sounds, and dysphagia. At birth, the glottis chink measures 7 by 4 mm. Narrowing of this chink causes most of the symptoms. Inability to cry is common. The little patient who cannot breathe properly presents a feeding problem: He will refuse all nourishment because he cannot breathe and swallow simultaneously. Stridor is usually inspirational, but may be expirational at times. Pressure on the trachea may be due to anomalies of the aorta or esophagus; therefore, examination by x-ray is the rule in all cases. Stridor usually disappears after the first year, but a congenital vascular ring requires surgery. Webs, next in frequency to stridor, occurred in 11 patients over a period of 20 years' experience; they were found at the anterior commissure, usually. The ventricular bands may be involved occasionally. Voice disturbance was the commonest symptom, either weakness or no voice, and no crying, but with obstructive dyspnea. The web must be incised, and the larynx dilated. But recurrence is common, and thyrotomy with complete excision, with insertion of a "tantalum keel," may be necessary. Congenital cysts cause hoarseness and obstruction. Surgery is imperative, and the results are good.

Congenital paralysis of the cords is unusual, but may occur from central hemorrhage, and is commonly bilateral. When the paralysis is unilateral, some cardiovascular anomaly is likely. Congenital stenosis has been reported by Tucker, Glaser, Landau, and Heatley. O'Kane (G. H.) reported a case in the *Laryngoscope* for July, 1936. Obstruction was subglottic, and one could not get through with a 3-mm. bronchoscope. Some three or four operations for removal of recurring scars were performed, followed by dilatation. The voice obtained as a result was "fair," and the patient was successful in college in making herself understood.

Other congenital conditions of lesser significance occur, namely, angiomas, cystic hygromas, tracheoesophageal fistulas, "autonomic reflexes," etc. Hemangiomas occur now and then, and are difficult to deal with.

The laryngologist has a great responsibility when confronted by these conditions. It is expected that the obstetrician will be the first to discover such lesions. In any case, the main objective is to secure good respiration and a satisfactory voice. External surgery may do harm if it alters the intrinsic structures: blood vessels and nerves. Cicatricial change or persistent swelling may defeat the purpose. The growth centers in the larynx may be stunted by whatever procedure, with resultant defect in development and laryngeal function. Eighteen references to the literature make this essay a complete and exhaustive study of a field in which relatively few laryngologists have a wide experience.

I. W. VOORHEES, New York.

VOCAL NODULES. JEAN TARNEAUD, Acta oto-rino-laring. ibero-am. **5**:336, 1954.

The author describes the pathologic anatomy, etiology, pathogenesis, and the symptomatology of vocal nodules. There are five principal types: 1. A small spinous nodule, usually 1 to 2 mm. in size. 2. The nodular, usually sessile nodule, which may involve the entire border of the vocal cord. This may either be edematous or have a fibrous appearance. 3. The "kissing" nodule. These are implanted on the free edge of the cord and approximate each other. 4. "Trophic inflection," usually found in long-standing cases. Here two arches of the vocal cord are produced, dividing the anterior third from the posterior two-thirds. There apparently is a hypertrophy of the thyroarytenoid muscles. These are usually bilateral. 5. A polyp of the vocal cord.

The treatment varies, depending upon the type of nodule. If one is dealing with a small fibrous nodule of recent origin, even though it may become edematous, surgery is contraindicated, since many of these yield to reeducation of the voice. The kissing nodules require surgical extirpation. The nodular type again should not be operated on, nor should the hypertrophic type. Emphasis is placed upon the need for both prophylaxis and vocal reeducation.

PERSKY, Philadelphia.

THERAPY OF ENDOBRONCHIAL TUBERCULOSIS. A. CASTELLA ESCABROS, Acta oto-rino-laring. ibero-am. **5**:349, 1954.

The author describes the importance of bronchial tuberculosis, stressing the pathology of various types, whether due to the rupture to the bronchus from the infected peribronchial glands or local ulceration, and secondary stenosis. The various types can be determined by bronchoscopy and radiology. The bronchoscopic treatment is of extreme importance, not only from the standpoint of aspiration of the secretion but also from that of cauterization of bronchial ulcers and the avoidance of secondary stenosis.

PERSKY, Philadelphia.

News and Comment

SOCIETY NEWS

International Association of Logopedics and Phoniatrics.—The Tenth International Congress for Speech and Voice Therapy will take place in Barcelona, Spain, Sept. 3-7, 1956.

Those practicing in the field of speech and voice therapy and in allied professions are invited to attend this Congress.

The following official reports will be presented:

Stuttering: Dr. Wendell Johnson (Iowa).

Neurology and Speech and Language Disorders: Dr. Antonio Subirana (Barcelona).

Nonverbal Tests of Intelligence and Maturity: Dr. Edeltrud Baar (Vienna).

Amusia: Dr. Augusta Jellinek (New York).

Those who propose to submit papers should notify the Organizing Secretary not later than January, 1956. No paper can be accepted unless a summary of not more than 100 words has been received by the Organizing Secretary before May 15, 1956.

Time limit for papers: 10 minutes.

Articles that have been previously published cannot be accepted for the Congress.

The official languages of the Congress are English, French, German, and Spanish.

Those desiring further details about the Congress please apply to the Oragnizing Secretary: Dr. J. Perelló, Provenza 319, Barcelona 9, Spain.

ANNOUNCEMENTS

The 1955-1956 Home Study Courses in the basic sciences related to ophthalmology and otolaryngology, offered as a part of the educational program of the American Academy of Ophthalmology and Otolaryngology, will begin on Sept. 1 and continue for a period of 10 months. Detailed information and application forms can be secured from Dr. William L. Benedict, the executive secretary-treasurer of the Academy, 100 First Avenue Building, Rochester, Minn. Registration should be completed before Aug. 15.

Books

Maxillofacial Anatomy. By Harry H. Shapiro, D.M.D. Price, $12.00. Pp. 369, with 314 illustrations (46 in color). J. B. Lippincott Company, E. Washington Sq., Philadelphia 5, 1954.

This is a commendably detailed book on its chosen subject. As a beginning, a background is presented of the embryological development of the head and its various parts; the cartilages and bones of the skull, the muscles, glands, the nervous and circulatory systems. This is followed by a description of the mature skull, including what is made visible on roentgen examination. The different regions of the face are considered in considerable detail, accompanied by illustrations of such gross pathological conditions as burns of the skin, developmental and other deformities. In the description of the upper respiratory system, the nose, nasal sinuses, and the larynx, with their blood and nerve supply, are presented from the viewpoint of applied anatomy. As would be anticipated, from the special interests of the author, the mouth cavity and all its parts are described fully, with attention given also to some technical details, as the reconstruction and restoration of abnormal conditions. Particular consideration is devoted to the glandular supply of the entire head, in unusual detail. The cranial nerves are included in their regular order, together with a brief analysis of the autonomic nervous system, and the clinical symptoms of some disordered states. Wounds of the face are given attention from the standpoint of applied anatomy, and methods of examination are included.

As a whole, the outstanding excellence of this manual is its concise and clear presentation in the text, accompanied by numerous illustrations in photographs, drawings, and roentgenograms. Some of the illustrations are credited to other sources, but many of them are original. There are 342 references to the literature. From the foregoing, the idea should be evident that this is a book of value both to the medical student and to the physician who is interested in becoming thoroughly acquainted with the applied anatomy of the head in general, and especially with the maxillofacial region.

Modern Occupational Medicine. By A. J. Fleming, M.Sc., M.D., and C. A. D'Alonzo, M.D., F.A.C.P. Associate Editor: J. A. Zapp, Ph.D. Price, $10.00. Pp. 388, with 44 illustrations (1 in color). Lea & Febiger, 600 S. Washington Sq., Philadelphia 6, 1954.

This book is a much needed modern interpretation of the various aspects of occupational medicine. It contains some 30 chapters, covering all aspects of occupational and preventive medicine, including a chapter on psychiatry. Of particular interest to otologists is an excellent chapter on Industrial Noise. This chapter gives a very penetrating and comprehensive review of the role of industrial noise in industry, and the part the physician and otologist should play. The authors discuss the difficulty in establishing damage risk criteria and the importance of a conservation of hearing program in industry. Since otologists will become more concerned with such a program, this book becomes a contribution in the field of otology.

Infection tubo-tympanique et surdites Labyrinthiques. By René Mayoux and Henri Martin. Price, 1,200 francs. Pp. 158, with 169 illustrations. Masson & Cie, 120 Saint-Germain Blvd., Paris-6e, 1954.

La voix. Cours international de phonologie et de phoniatrie de paris (1953). Under the direction of Professor A. Aubin. By various authors. Price, 5,000 francs. Pp. 434, with 300 illustrations. Librairie Maloine S.A., 27 rue de l'École-de-Médecine, Paris 6e, 1953.

A Primer of Pulmonary Function. By Harold Guyon Trimble, M.D., and James Kieran, M.D. Price, not given. Pp. 22, with one chart and two tables. Printed through the cooperation of the California Tuberculosis and Health Association. Authors' address: 2930 Summit, Oakland, Calif., 1954.

Directory of Otolaryngological Societies *

FOREIGN AND INTERNATIONAL

Canadian Otolaryngological Society
(Société Canadienne d'Otolaryngologie)

President: Dr. G. Edward Tremble, 1390 Sherbrooke St. West, Montreal, P. Q.
Secretary: Dr. G. Arnold Henry, 170 St. George St., Toronto.
Place: Bigwin Inn, Lake of Bays, Muskoka, Ont. Time: June 16-18, 1955.

International Bronchoesophagological Society

President: Dr. André Soulas, 184 Avenue Victor Hugo, Paris 16.
Secretary: Dr. Chevalier L. Jackson, 3401 N. Broad St., Philadelphia 40.

International Congress of Audiology

Place: Leyden, Netherlands.
General Secretary: Dr. H. C. Huizing, 182 Oostersingel, Groningen, Holland.

International Course in Paedo-Audiology

Place: Groningen, Netherlands.
General Secretary: Dr. H. C. Huizing, 182 Oostersingel, Groningen, Holland.

Pan-American Association of Oto-Rhino-Laryngology and Broncho-Esophagology

President: Dr. Juan Manuel Tato, Azcuenaga 235, Buenos Aires, Argentina.
Secretary: Dr. Chevalier L. Jackson, 3401 N. Broad St., Philadelphia 40.
Meeting: Fifth Pan-American Congress of Oto-Rhino-Laryngology and Broncho-Esophagology.
Place: San Juan, Puerto Rico. Time: February, 1956.
President of Congress: Dr. Juan H. Font, Medical Arts Building, San Juan.

Sixth International Congress of Otolaryngology

President: Dr. Arthur W. Proetz, 3720 Washington Blvd., St. Louis.
General Secretary: Dr. Paul H. Holinger, 700 N. Michigan Ave., Chicago 11.
Place: Hotel Statler, Washington, D. C. Time: May 5-10, 1957.

NATIONAL

American Medical Association, Scientific Assembly, Section on Laryngology, Otology and Rhinology

Chairman: Dr. Francis W. Davison, Geisinger, Memorial Hospital, Danville, Pa.
Secretary: Dr. Hugh A. R. Kuhn, 112 Rimbach St., Hammond, Ind.
Place: Atlantic City, N. J. Time: June 6-10, 1955.

American Academy of Ophthalmology and Otolaryngology

President: Dr. Algernon B. Reese, 73 E. 71st St., New York 21.
Executive Secretary-Treasurer: Dr. William L. Benedict, 100-1st Ave. Bldg., Rochester, Minn.
Place: Palmer House, Chicago. Time: Oct. 9-15, 1955.

* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.

American Board of Otolaryngology

President: Dr. Frederick T. Hill, Professional Building, Waterville, Maine.
Secretary-Treasurer: Dr. Dean M. Lierle, University Hospitals, Iowa City.
Examinations: Hotel Marshall, Richmond, Va., March 6-10, 1955; Palmer House, Chicago, October, 1955.

American Broncho-Esophagological Association

President: Dr. Clyde A. Heatly, 11 N. Goodman St., Rochester, N. Y.
Secretary: Dr. F. Johnson Putney, 1719 Rittenhouse Sq., Philadelphia 3.
Place: Hollywood Beach Hotel, Hollywood, Fla. Time: March 15-16, 1955 (afternoons only).

American Laryngological Association

President: Dr. Henry B. Orton, 224 Delavan Ave., Newark 4, N. J.
Secretary: Dr. Harry P. Schenck, 326 S. 19th St., Philadelphia 3.
Place: Hollywood Beach Hotel, Hollywood, Fla. Time: March 13-14, 1955.

American Laryngological, Rhinological and Otological Society, Inc.

President: Dr. Kenneth M. Day, 121 University Place, Pittsburgh.
Secretary: Dr. C. Stewart Nash, 708 Medical Arts Bldg., Rochester 7, N. Y.
Place: Hollywood Beach Hotel, Hollywood, Fla. Time: March 15-16, 1955 (mornings only).

SECTIONS:

Eastern.—Chairman: Dr. Benjamin H. Shuster, 1824 Pine St., Philadelphia 3.
Southern.—Chairman: Dr. G. Slaughter Fitz-Hugh, 104 E. Market St., Charlottesville, Va.
Middle.—Chairman: Dr. James E. Croushore, 3001 W. Grand Blvd., Detroit.
Western.—Chairman: Dr. Victor Goodhill, 2007 Wilshire Blvd., Los Angeles.

American Otological Society, Inc.

President: Dr. D. E. Staunton Wishart, 170 St. George St., Toronto 5, Canada.
Secretary-Treasurer: Dr. John R. Lindsay, 950 E. 59th St., Chicago 37.
Place: Hollywood Beach Hotel, Hollywood, Fla. Time: March 17 (afternoon), 18 (forenoon and afternoon), and 19 (forenoon), 1955.

American Otorhinologic Society for the Advancement of Plastic and Reconstructive Surgery, Inc.

President: Dr. Matthew S. Ersner, 1915 Spruce St., Philadelphia 3.
Secretary: Dr. Louis Joel Feit, 66 Park Ave., New York 16.

American Society of Ophthalmologic and Otolaryngologic Allergy

President: Dr. F. Lambert McGannon, 14595 Madison Ave., Lakewood, Ohio.
Secretary-Treasurer: Dr. Michael H. Barone, 468 Delaware Ave., Buffalo 2.
Place: Palmer House, Chicago. Time: 1955.

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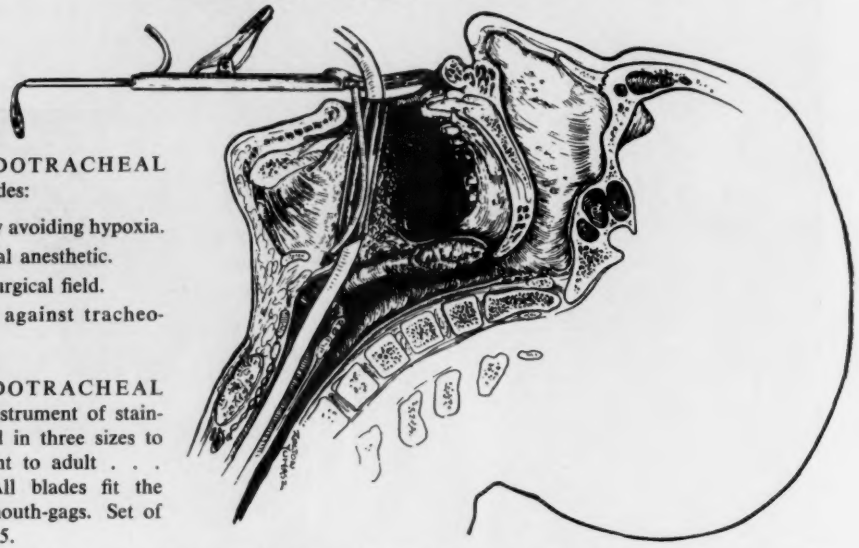

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*Barton, R. T.: Instrument for endotracheal anesthesia during oro-pharyngeal surgery. J. A. M. A. 153:1017 (Nov. 14) 1953.

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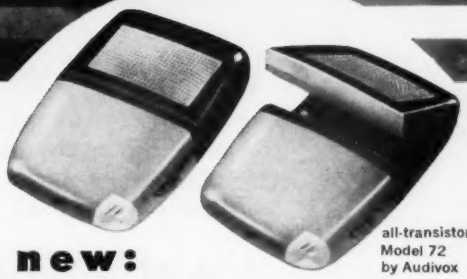

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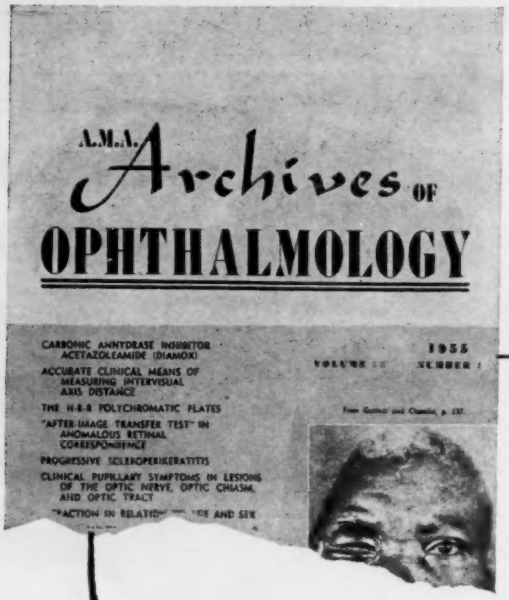
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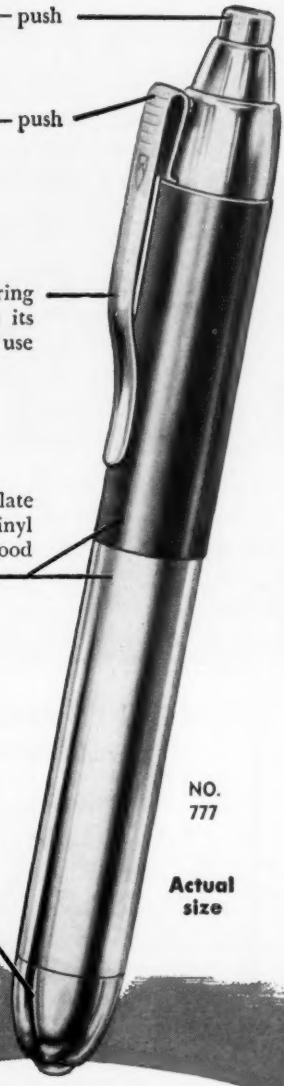

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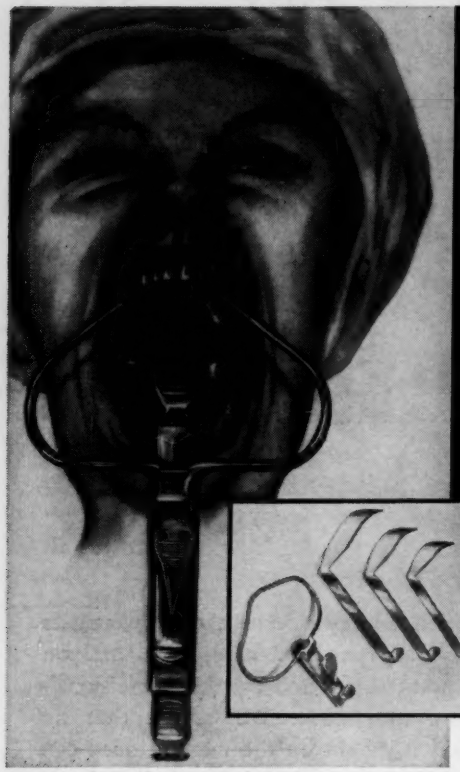

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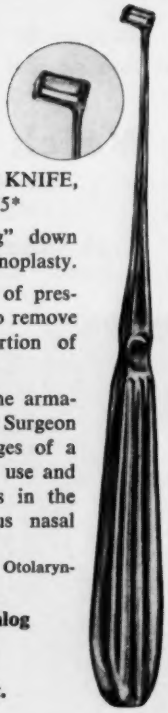

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* See page 508, A. M. A. Archives of Otolaryngology, October 1954.

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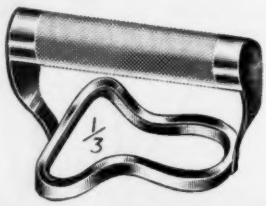

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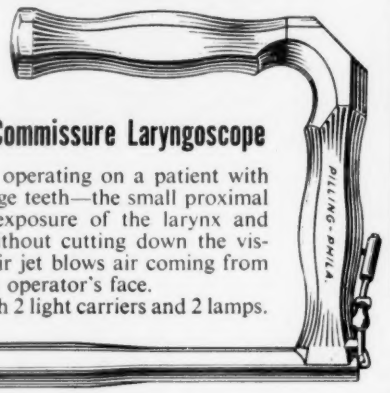

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